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NAVAL POSTGRADUATE SCHOOL

Monterey, California



THESIS

**LESSONS LEARNED FROM A WEB BASED
DISTRIBUTED LEARNING CASE STUDY: EVALUATION
OF COURSE DESIGN, MODULES, EFFECTIVENESS, AND
STUDENTS' PERFORMANCE AND REACTIONS**

by

Miroslav Komar

June 2001

Thesis Co-Advisors:

James E. Suchan
Bernard Ulozas

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STUDY: EVALUATION OF COURSE DESIGN, MODULES, EFFECTIVENESS,
AND STUDENTS' PERFORMANCE AND REACTIONS**

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Submitted in partial fulfillment of the
requirements for the degree of


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from the

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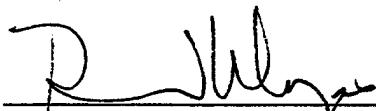


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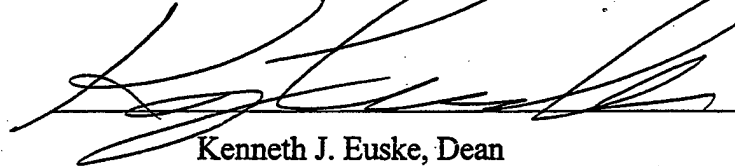
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ABSTRACT

This thesis evaluated the first iteration of Navy Postgraduate School (NPS) on-line course 'Space Systems – Technology and Applications'. The thesis goal was to evaluate: course design; course effectiveness; student expectations and motivation before and affective reactions after the course; and typical patterns of on-line learning behavior according to Long's theory. Ultimately, the thesis intended to derive lessons learned and recommendations for future distributed learning (DL) courses and future research in this area.

There were thirty regular, resident NPS students in the sample. Data was collected from nine sources: four on-line questionnaires, Student Opinion Forms, on-line tracking, final grades, interviews with students, and interviews with the instructor.

Even though the course first course taught by this instructor, it was successful. Student expectations, motivation, affective and utility reactions were predominantly positive. For students, the most important advantage of the course was time flexibility and convenience. Students and the instructor agreed about central role of interactivity/feedback in a DL, which should be included into models of training effectiveness evaluation. Long-Dziuban's protocol results were surprising, but solid conclusions cannot be made without focused research. Results provided several recommendations about the course design, pedagogical improvements, instructional counseling, and future research.

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I. INTRODUCTION

This chapter provides the reader with the background that led to the creation of this thesis, outlines the theoretical models that guided and directed the research, supplies the thesis purpose and the research questions, briefly reviews the thesis scope and methodology, and provides an overview on the organization of the study.

This thesis tests a model of a web-based course evaluation, based on specific theoretical bases, which are described later in this chapter and in Chapter II. This model determines the research questions of this thesis, its methodology, and the study's organization.

My intention is to evaluate the utility of the model through the qualitative and quantitative analysis of data collected in this case study research in the context of relationships and factors that this model would predict. Lessons learned from the case study should primarily have practical applicability. However, the study might also provide conclusions in terms of known models and their possible modifications and improvements.

A. BACKGROUND

This section provides a brief description of events, circumstances, and theoretical concepts that explain the need for this research.

Several years ago, the Chief of Naval Education and Training (CNET), U.S. Navy, intending to enhance education and training opportunities for Navy personnel and being aware of an increasing importance of distributed learning (DL) in contemporary

education and training, initiated an idea for a pilot project. The project did not have an official name, but in fiscal year 1999 all stakeholders agreed to the project and CNET ensured its funding. Decision-makers concluded that the Naval Postgraduate School (NPS) was an excellent place to run the pilot program. NPS agreed to transform several of its courses in the Information Systems and Operations (ISO) curriculum¹ into web-based, on-line courses and to deliver them. In the first phase, the program would include two courses, one of which was 'Space Systems - Technology and Applications' taught in the Space Systems Academic Group. In total, the plan was to gradually transform twelve to fourteen courses to DL versions. By the end of 2000 four courses were on-line, and six more were planned for 2001.

The reasons for such broad distributed learning initiatives in the military are understandable. The modern military organization is very information-oriented and highly training-demanding because of the rapid development of military technologies. The vision for future battlefields is interactive and network-centered with communications playing a crucial role. Distributed learning is one of the inevitable, powerful training tools the military needs to obtain such a vision. During the last 10 years, U.S. and foreign universities, other educational institutions, and companies in general have instituted DL courses and programs. Progress in this instructional area has been very rapid.

Before going further, I have to precisely define the central theme in this thesis: distributed learning. Bates (1999), in his excellent book 'Managing Technological

¹ ISO includes Information Operations and Information Warfare curricula.

Change' (p. 27), quotes the definition of distributed learning by the Institute for Academic Technology, University of North Carolina:

A distributed learning environment is a learner-centered approach to education, which integrates a number of technologies to enable opportunities for activities and interaction in both asynchronous and real-time modes. The model is based on blending a choice of appropriate technologies with aspects of campus-based delivery, open learning systems, and distance education. The approach gives instructors the flexibility to customize learning environments to meet the needs of diverse students populations, while providing both high-quality and cost-effective learning.

Later in his text, Bates (1999) continues elaborating on this terminology (p. 28):

New technologies are leading to major structural changes in the management and organization of teaching. These developments are increasingly being referred to in the United States and Canada as *distributed learning*, in the United Kingdom as *networked learning*, and in Australia as *flexible learning*.

Belanger and Jordan (2000, pp. 49-53, 71-86) divide computer-aided instruction (CAI) into four main groups:

- Web-based training (WBT)
- Teleconferencing
- Videotape instructions
- Video tele training (VTT)

This thesis is focused on WBT. In Belanger and Jordan WBT, with the Internet as a primary medium for delivery of instruction, is then divided into:

- Web Enhanced Courses – traditional classroom combined with Web technologies
- Web Managed Courses – where all course management, testing, collaboration, instructional material, etc. are on-line
- Web Delivered Courses – all materials available through the Web, including tools for real-time collaboration and interactivity
- Hybrid Delivery – partial Web and partial CD-ROM course delivery

This conceptual division of WBT still does not provide a sufficiently precise definition. Williams, Paprock, and Covington (1999) provide a developmental continuum of distance learning, where the third level of development is closest to the term 'distributed learning' (Figure 1).

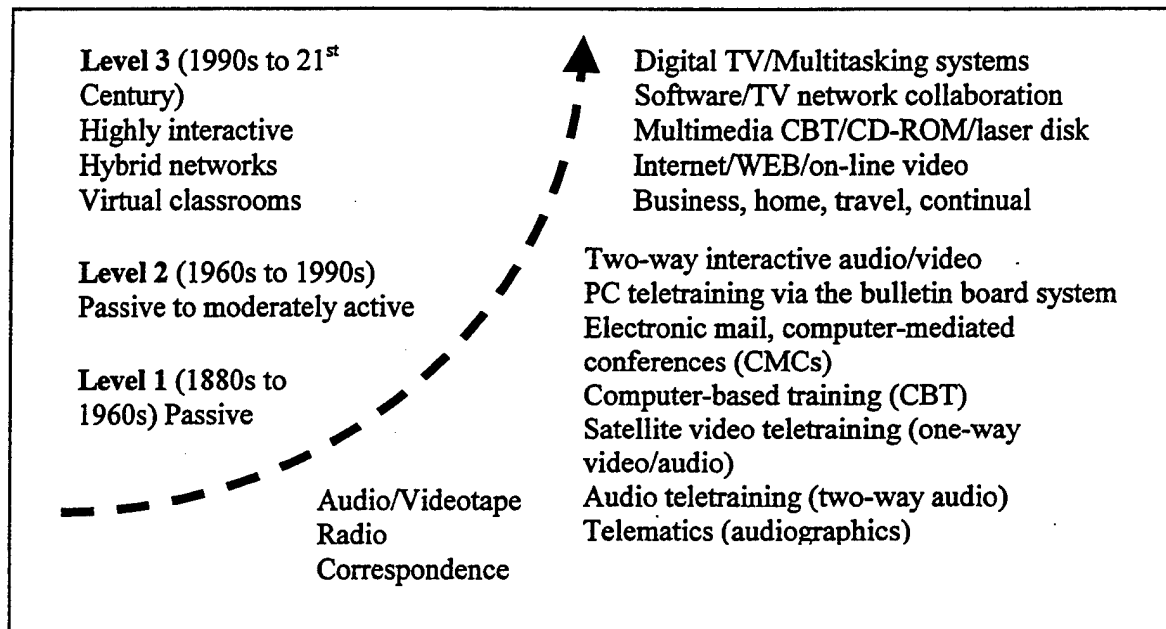


Figure 1. Distance Education Continuum [From: Williams, Paprock, and Covington (1999)].

This continuum shows the way multi-media based learning has evolved through the years, highlighting the development of interactive delivery environments. Level 1, the most passive form of distance learning, consists of printed material, audio/videotapes, and radio transmission. This type of learning is asynchronous because the instructor and student transmit messages only one-way and receive responses after a lengthy delay. Level 2 is passive to moderately active, and includes two-way audio training, one-way video/two-way audio tele-training, computer-based training (CBT), CD-ROMs, laser disk, e-mail, computer-mediated conferences, audio graphics, laser disks, and other similar media. It is considered synchronous. Level 3 is a highly interactive learning

environment, and the content of a course determines which technologies would be used as a primary instructional form of delivery. At this level, hybrid environments and all distributed learning technologies mentioned above, including the Internet and World Wide Web, are combined into a 'virtual classroom'.

Moskal and Dziuban (2000, p. 2) quote Moore and Kearsley's definition of distance education:

[Distance education is] planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic or other technology, as well as special organizational and administrative arrangements.

In the same text (p. 3), Moskal and Dziuban added an important note: 'University of Central Florida (UCF) uses the term distributed learning because courses offered involve distributing instruction using various media to students that may not, by definition, be at a distance'. In other words, DL, as defined by UCF, is mostly web-based and on-line, but may include videotape, two-way interaction television, and other similar media.

Hartman, Dziuban, and Moskal (1999, p. 2) further explain how the University of Central Florida defines and divides asynchronous learning networks (ALN), which is very close to the term 'distributed learning' used in this thesis:

ALN activity at UCF is characterized as one of three types. Web-enhanced ('E') courses are those using the Web in a useful but incidental manner. Typically, on-line materials are provided as supplemental or enrichment resources. All 'E' courses use WebCT as a repository for course materials, resource links, or for conferencing and e-mail. Media-enhanced ('M') courses make significant use of the Web as an integral element of course delivery. Currently, some 'M' courses have a reduced number of class meetings (reduced seat time), using ALN activities to replace traditional class meetings. Fully-based courses are designated 'W', and have no

required class meetings. Some have an optional pre-course orientation and/or required final examination.

This definition is much more appropriate for the needs of this thesis, because the course this thesis examines was designed and delivered based on the “UCF ‘W’ course model”. From here on, by DL (unless stated differently) I mean **asynchronous, web-based course/training**, but with the small possibility of some non – on-line content. The course this thesis assesses is closest to the ‘W’ model stated above. By synchronicity I mean that time must be scheduled for the on-line meetings to be held, with all participants available at that time.

B. ON-LINE EDUCATION

Students of all ages and instructors worldwide are witnessing an explosion of on-line education – evidence of this statement is visible in mass media, campuses, and in everyday life. The best example is the British Open University (<http://www.open.ac.uk>), the world’s largest and most successful DL institution.

The following examples are listed in Kearsley’s ‘Online Education’ (2000). One of the U.S. leaders working with schools and creating worthwhile learning programs is NASA (<http://www.nasa.gov>), which provides exciting help in its subject matter to school children and adults. Companies heavily involved in school networking are, for instance, Pacific Bell (<http://www.kn.pacbell.com>) and Hewlett-Packard (<http://www.hp.com>).

It is impossible to list all of the other good examples of specific areas in on-line learning. There are sites for the senior learning community (<http://www.seniornet.org>), for the disabled (<http://www.rit.edu/~easi>), for teachers (<http://www.webteacher.org>), and even about how to learn on-line (<http://www.mtsu.edu/~studskl>) or

<http://www.familyeducation.com>). Also, there are paper and cyber periodicals and magazines devoted to on-line education, like 'Syllabus' (see <http://www.syllabus.com>), and numerous conferences every year.

The web-based version of SS3011 'Space Systems - Technology and Applications' served as a pilot-course and a beta test to evaluate if course material could be delivered effectively via the Internet. Accordingly, the specific intention of the thesis is to examine the course, to evaluate its outcomes, to analyze how effective it was in terms of meeting course objectives, and to identify the problems, the obstacles, and other major factors, which played significant roles in the effectiveness of the course.

The course was the first designed and taught by the instructor, Commander Susan Higgins. It was the first on-line web-based course prepared and delivered in the Space Systems Academic Group at NPS. Prior to teaching the course, the instructor participated in a faculty training course entitled 'Interactive Distributed Learning for Technology-Mediated Course Delivery' (IDL 6543), at the University of Central Florida, Orlando, FL.

UCF began training faculty to design and develop on-line courses in June 1996, and over 150 UCF faculty have attended the IDL 6543 course. The Course Development and Web Services Department at UCF not only helps faculty in integrating technology and media to transform the learning process but also provides multimedia courseware, software and databases, learner support for success in technology-mediated classes, support web site development including the University's primary site, and research and develop advanced technological applications (Barbara Truman-Davis: Brochure on Course Development & Web Services, UCF [2000]). The IDL course's site is located at

<http://reach.ucf.edu/~idl6543>, learner support at <http://reach.ucf.edu/~coursdev/learning> and <http://reach.ucf.edu/~coursdev/cdrom>, and information about WebCT, UCF web-based course management tool is at <http://reach.ucf.edu/~coursdev/webct/support.html> (UCF [2000]). More information about WebCT can be found at <http://www.webct.com> (UCF [1999]).

The 'UCF model' of distributed learning is well known and recognized nationally and internationally. UCF received an APOQ-SHEEO (American Productivity and Quality Center and the State Higher Education Executive Officers) faculty development award in 1998. The United States Distance Learning Association (USDLA) awarded UCF in 1999 the 'Excellence in Distance Learning Programming Award in Higher Education for its educational use of distance learning media, including the World Wide Web, interactive television, radio, and TV tapes. Also, in 1999 it was granted \$200,000 from the Pew Learning and Technology Program at the Center for Academic Transformation as part of the Pew Grand Program in Course Redesign.

C. PURPOSE

This thesis evaluates the SS3011 course 'Space Systems - Technology and Applications' taught during the summer quarter of academic year 2000 at NPS. My goal was to employ a case study approach that embodied components of a theoretical model of web-based learning effectiveness.

The research evaluates the following:

- Course design – course objectives, content, and course activities as well as pedagogical strategies used in that design.
- Course effectiveness in terms of student learning.
- Student expectations and motivation before the course and affective reactions after taking the course

- Typical patterns of online learning behavior.
- Student confidence in applying skills and competencies in future jobs

Most importantly, this research integrates the above-mentioned variables into an interactive system so as to understand better the influences of these factors on each part of the learning process in the course.

D. RESEARCH QUESTIONS

Primary research questions include the following:

- How successful was the web-based SS3011 course design in meeting learning outcomes?
- What were the students' expectations, motivation, on-line behavior patterns, cognitive outcomes, affective-type reactions, and utility-type reactions during and after the course?
- What recommendations for course improvement, and what lessons learned (in general) could be derived from the case analysis of this course?

Secondary research questions:

- How effective were the course organization, pedagogy, and technology in meeting course objectives?
- What are recommendations for future evaluations and research on this course and other DL courses in future?

E. METHODOLOGY REMARKS

The process of collecting data necessary for this thesis was shaped by the following factors:

- The ongoing course was the primary priority. The research required limited interference with the learning process, i.e. not disturbing either the instructor or the students.
- Students voluntarily cooperated in the research. If any student, for whatever reason, refused to participate at any time during the course, that decision was honored. None of the students refused participation, but some skipped some of the questionnaires and the interview. This phenomenon of students skipping or not giving feedback is an interesting issue itself and will be addressed in other chapters.

- I was obligated to guarantee the protection of the students' identity and proper use of all collected data. In accordance with this element of the research, I do not mention student names in the thesis.
- The number of students was not large – thirty-one students successfully finished the course. Consequently, this thesis uses the case study approach with the intention of doing qualitative and quantitative analysis.
- The sample had to be limited only to students who met following important characteristics: they were regular students of the course and later had successfully completed it, and they were resident students at NPS.

There were four main sources of data relevant for this case study:

- Demographic data, student biographies, their grades, all student activity tracking data collected in software used in the course (WebCT), and Student Opinion Forms (SOFs).
- Evaluation questionnaires put on-line only for the purpose of this thesis. There were four such instruments (Appendices A through D).
- Individual semi-structured interviews I conducted with 17 students after the course was over (Appendix E).
- Extensive interviews I conducted with the instructor, mostly after the course

Detailed illustrations and discussions on all these sources and data are in Chapter III (Methodology) and in Chapter IV (Results and Data Analysis).

F. ORGANIZATION OF THE THESIS

I review the relevant literature in Chapter II. Chapter III deals with the methodology and data collecting issues. Chapter IV describes and analyzes all collected data. It is followed by a discussion and analysis of the results and their implications in Chapter V, and by conclusions and recommendations in Chapter VI.

II. LITERATURE REVIEW

A. HISTORICAL PREDECESSORS AND THE INTERNET

The U.S. President Dwight Eisenhower established the Advanced Research Project Agency (ARPA) in 1958 as part of the Defense Department in order to improve the new national commitment to science and to bolster national defense (Moschovitis and others, 1999, pp. 35-36). ARPA began to explore the possibilities of information processing and computers under the visionary leadership of Joseph C. D. Licklider. Searching for new ways to improve human productivity, ARPA conducted extensive research on the feasibility of connecting computers across long distances. In 1965, Larry Roberts connected his computer in the Boston area via a phone line with another in California, which was the entry into an entirely new era: the era of the Internet.

Licklider and his team imagined a universal computer network. Ted Nelson coined the terms 'hypertext' and 'hyperlink' in 1965, and in 1969 ARPAnet is born: the first multiple-site computer network, sponsored by the U.S. Department of Defense.

ARPAnet started as an experimental, four-computer network. By 1971, ARPAnet linked almost two dozens sites, including MIT and Harvard. By 1974, there were over 200 sites. During the 1980s, more and more computers using different operating systems were connected. In 1983, the military portion of ARPAnet was moved onto MILnet, and ARPAnet was officially disbanded in 1990. In the late 1980s, the National Science Foundation's NSFnet began its own network and allowed everyone to access it. It was, however, primarily the domain of 'techies', computer-science graduates, and university professors. Finally, in 1991 Tim Berners-Lee developed the World Wide Web at CERN (Centre Européen pour la Recherche Nucléaire – European Laboratory for Particle

Physics) in Geneva. This event definitely opened the door to the unlimited development of the Internet society.

According to the newest surveys (Nielsen/NetRatings, online resource, December 2000), today over 153 million Americans use the Internet from their homes. Accesses to the Internet increases by 5.3% monthly, and trends are similar in many other countries such as the United Kingdom, Japan, and Scandinavian countries. The process of gradual integration of telephony, radio broadcasting, and TV with the Internet is rapidly increasing. It is predicted that by 2005 over one billion people may be connected to the Internet (Simon & Schuster New Millennium Encyclopedia and Home Reference Library, 2000, topic 'What is the Internet').

The speed at which the Internet is spreading is incredible. Radio existed 38 years before 50 million people tuned in. It took television 13 years to reach 50 million viewers. After the introduction of the first personal computer kit, it took 16 years before 50 million people were using one. However, within only four years of the Internet being available to the general public, 50 million people were connected (Simon & Schuster, same topic).

B. EVALUATION OF DL EFFECTIVENESS

Many practitioners have recognized evaluation as an integral part of a lifecycle methodology in any instructional systems design (ISD) model. Course evaluation is a consistent part of the 'UCF model' of DL practice also.

Belanger and Jordan (2000) describe the following model, called 'ADDIE', as most commonly used. It includes five key phases:

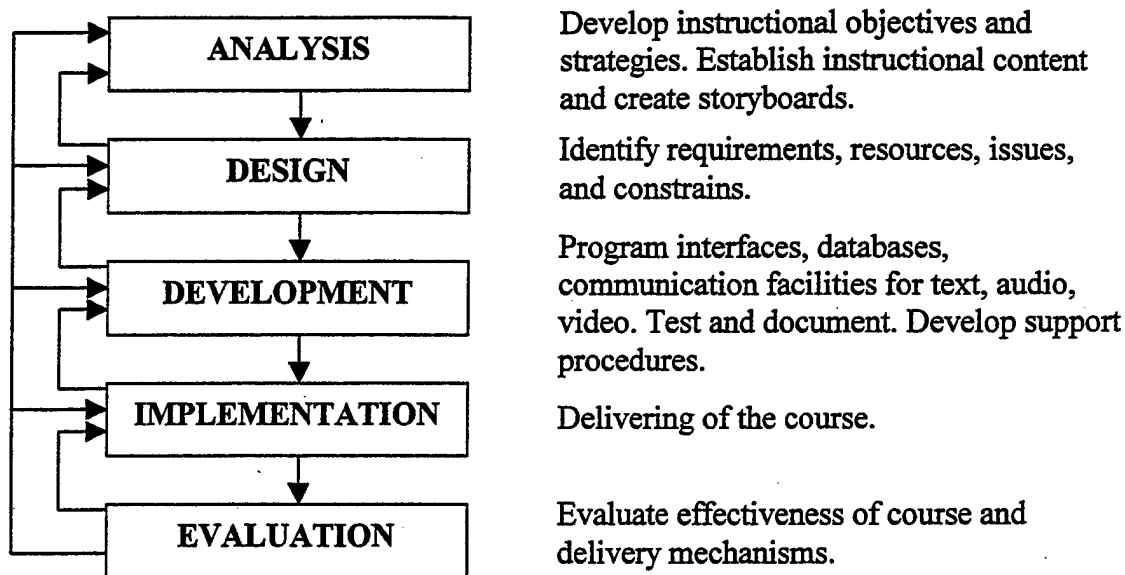


Figure 2. ADDIE Model for DL Projects [From: Belanger and Jordan (2000), p. 90].

Even a quick examination of relevant literature shows that there is a large amount of research on the effectiveness of web-based or web-enhanced education and training. However, few researchers have tried to capture several aspects of the process simultaneously. An education or training process is a complex, multidimensional activity. Concentrating on only some aspects of the process may miss important, subtle factors important for overall effectiveness.

There are not many theoretical models analyzing training effectiveness. The most useful are Kirkpatrick's Four Levels of Evaluation model, Marshall and Shriver's Five Levels of Evaluation Model, and Van Slyke's Framework. This thesis anchors these training effectiveness models, using SS3011 as a data source, to determine which of these models is effective in assessing web-based instruction.

Kraiger, Ford and Salas (1993) offered the following classification of learning outcomes:

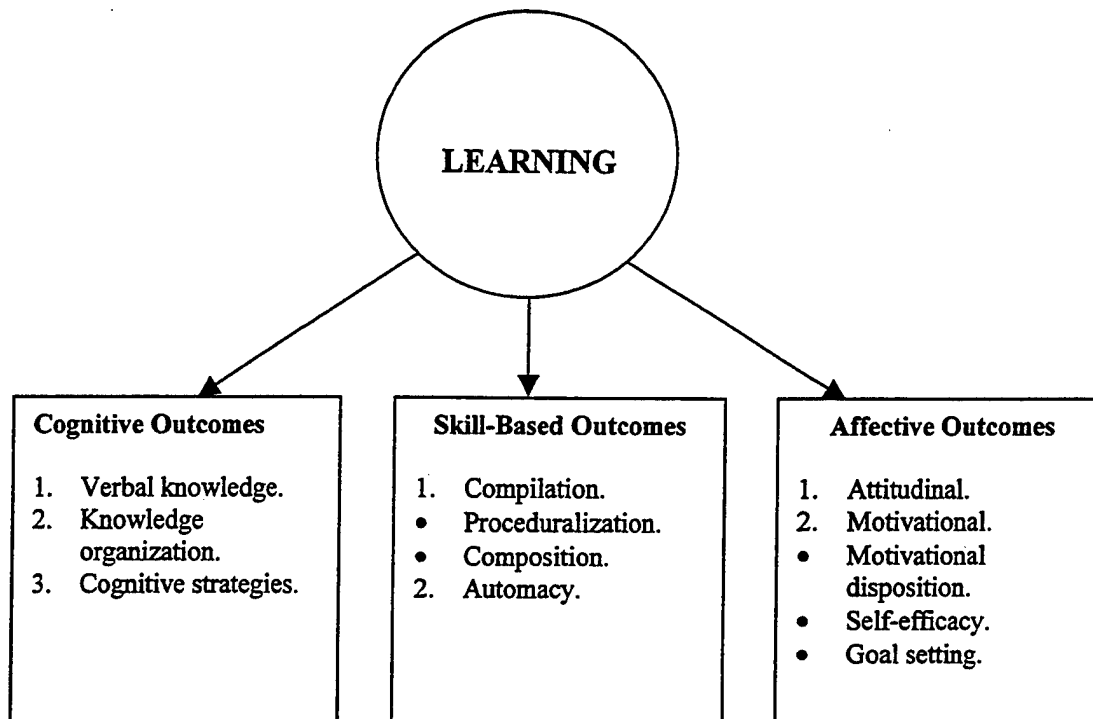


Figure 3. Kraiger, Ford and Salas' Classification of Learning Outcomes. [From: Kraiger, Ford & Salas (1993), pp. 311-328].

Their model systematizes learning outcomes into three basic clusters and analyzes each of them in depth. Cognitive outcomes in their model are very close to Kirkpatrick's knowledge transfer, affective outcomes close to learner reactions, and skill-based outcomes to behavior transfer.

Kirkpatrick's model [Alliger and others (1997), pp. 342-343; Belanger and others (2000), pp. 191-192] is still the most influential and is a starting point for other models. It differentiates between four categories of training criteria: Learner reactions; learning or knowledge transfer; behavior transfer; and organizational impact. Researchers often use this model to evaluate the impact of the learning experience at affective, cognitive, behavioral, and organizational levels.

According to Kirkpatrick's model, learner reaction as a first level of evaluation is affective in nature, which can be assessed by surveys, questionnaires, focus groups, and interviews. What is essential is that this level is a personal reaction to the learning experience. Knowledge transfer is about what is actually learned. It is hard to measure this level of learning, but it is most essential in measuring the effectiveness of the learning experience, compared to the other learning objectives. Knowledge tests are often present in DL courses, which enables the learner to assess his own progress and obtain feedback. Another component in Kirkpatrick's model, behavior transfer assessment, deals with measurable, observable behavioral changes. Unfortunately, this component is often not measured. Assessment methods at this level of evaluation include time-consuming 360 degrees surveys. Organizational impact measures are usually focused on improvements (service response time, service quality, etc.) that increase the return on investment. These are not causal measures and are outside the scope of this thesis.

Baldwin and Ford (1988) describe training design as one of the main training input factors in the following theoretical model of the knowledge transfer process (Figure 4). In terms of their model, this thesis focuses on learner characteristics and learning design as inputs, and learning and retention as outputs. Furthermore, relationships between them are of special importance for this research because the system approach by definition focuses on relationships between elements and subsystems inside the system, as well as input into and output from the system.

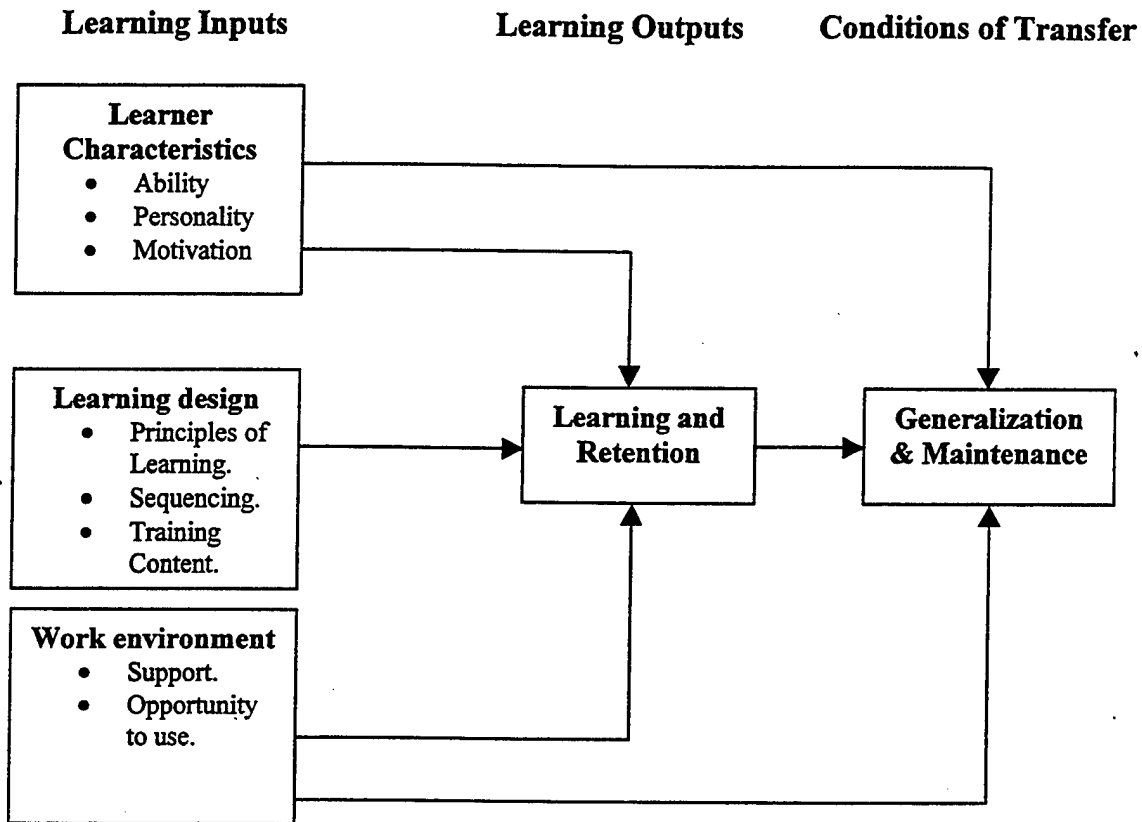


Figure 4. Baldwin and Ford's Model of Learning Design [From: Baldwin & Ford (1988), p. 65].

Another very interesting, and for this thesis a useful model, is proposed by Van Slyke, Kittner and Belanger (1998). It suggests that multiple variables must be taken into account concurrently in looking at their effect on distance education [Belanger & Jordan (2000), pp. 187-190]. Their framework targets *distance education*, not distributed learning in the sense I defined and used in this thesis. Their theoretical model addresses the wider spectrum of learning environments, including VTT, WBT, and others. They emphasize that their framework can be used to conceptualize the learning environment where the learner is embedded in all its complexity. All key dimensions are present in the model: the institution, the learner, the course, and the type or types of distance education applied. Moreover, they stress that all evaluation programs should explicitly define which

of these categories of variables are being measured, which are being controlled, and what the outcome variables are.

Belanger and Jordan go a step further, adapting Van Slyke's model (Figure 5).

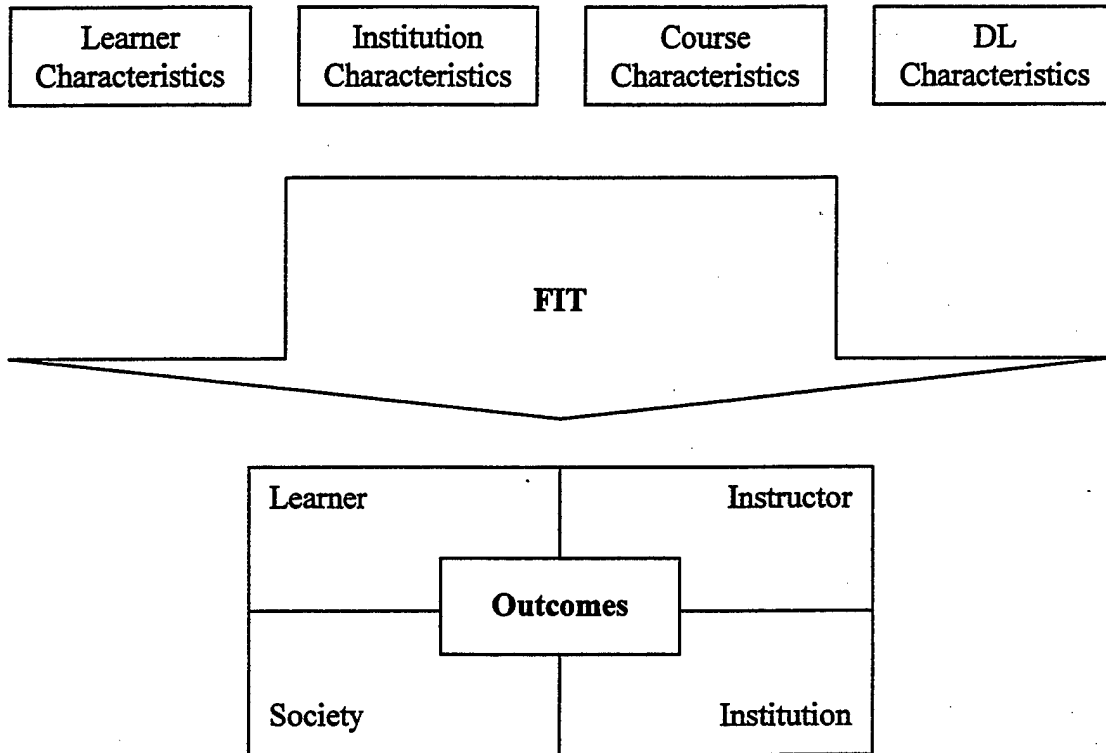


Figure 5. Framework for Distance Education and Training [From: Belanger & Jordan (2000), p. 189].

This framework, which builds on the previously mentioned models, gradually evolved from the analysis of learning outcomes to a very broad view including even society. Comparing Baldwin & Ford's model with Belanger and Jordan's, we find that new determinants and categories of outcomes are added. Learner characteristics are present in both models. While Baldwin and Ford outline learning design, Belanger and Jordan differentiate course characteristics and DL characteristics. The last learning input

for Baldwin and Ford is the work environment, but for the latter two authors it is institution characteristics and society. Belanger and Jordan (2000, p. 186) comment:

All of these characteristics and variables must be carefully examined, not in isolation, but together in evaluating the appropriateness for an individual, a course, and an organization to attend, convert, or implement DL. We want to extend the model to include four different units of analysis impacted by DL: the learner, the instructor, the institution, and the society.

They also add that there are two levels of outcomes and thus two measures of success (or efficiency): one for institutions and one for students. As Figure 5 shows, they extended the number of units of analysis impacted by DL to four: the learner, the instructor, the institution, and society.

C. OTHER FACTORS OF DL EVALUATION

Phipps and Merisotis (1999), after analyzing a large amount of original studies on DL since 1990, concluded that most of the studies measured effectiveness of DL in one, less frequently two, and very rarely in three of the following areas:

- Student outcomes, such as grades and test scores
- Student attitudes about learning through distance education.
- Overall student satisfaction toward distance learning

In other words, most of the studies concentrated only on some aspects of the learning process and neglected other relevant parts of the system. They found serious methodological weaknesses in most of the studies and concluded that there was a paucity of original, legitimate research dedicated to explaining or predicting phenomena related to DL. According to their review, approximately 28% of DL research studied two-way interactive video technologies, 28% studied computer-mediated learning, 16% studied one-way broadcast technologies, 13% one-way prerecorded video, 6% two-way audio and one-way video learning, and 9% studied other technologies. The main research

methods applied were: experimental 51%, descriptive 31%, case study 15%, and correlational 3%.

Suchan and Crawford (1998) analyzed implementation of network-based instruction (NBT) to senior Navy medical executives, emphasizing in introduction the unique effects of technology on learner and on interaction between learner and instructor, as well as between learners. Their thorough analysis provided several recommendations at different organizational levels of a learning process. Here is the selection of recommendations most relevant to a course like SS3011:

- **Formal organizational arrangements:** provide appropriate technology and training to use that technology; provide technological support.
- **Informal organization:** program evaluation should be conducted at several points in time to account for the effects of exposure to the medium; use a qualitative methodology, i.e., interviews, to capture factors that might be not anticipated by instructional designers.
- **Instructional task design factors – perceived meaningfulness:** show clear indication of the module's purpose; define the module learning states from a personal and organizational perspective; ensure that instructional objectives are reflected in all evaluation measures; develop an overview of topics to be covered to further provide learning constraints; implement constant summaries that rearticulate module purpose.
- **Instructional task design factors – perceptions of choice:** create hot links (hypermedia) to other Web sites; monitor and feedback learners' choice of information search strategies so that they become more aware of the search patterns and structures they use; use open-ended questions based on readings, scenarios; encourage (students) to share their own and respond to other's experiences in these electronic venues; provide immediate and direct access to a 'real' instructor for problems and feedback on the program.
- **Instructional task design factors – perception of competence and progress:** provide carefully timed, ongoing feedback on progress toward achieving module goals; vary feedback style based on module learning outcomes; use positive language to frame all types of electronic feedback.

The authors conclude their recommendations with very important point that feedback is, in essence, interactivity, what is of exceptional relevance for this thesis.

Moskal and Dziuban (2000) in introduction of their paper 'Present and Future Directions for Assessing Cyber-Education' analyzed evaluation strategies from standpoint of the University administration. According to them, evaluation is important to determine both the initiative's progression and ultimately its success. It is important, they explain, to track longitudinally the impact of on-line courses on students and faculty. In summary, they outline five assumptions of web-based teaching and learning evaluations:

- Research should inform practice
- Evaluation must be contextually relevant
- Faculty must be rewarded as research leaders
- Evaluation must be seen as an integral part of the initiative
- As evaluation matures its demonstrable impacts must be obvious.

The authors analyzed in detail data on both students and the faculty at UCF. Eighty-nine percent of web course students were very favorable about taking another course, and 70% of them indicated they would definitely take another on-line course. As main reason for enrolling on-line course, students mostly indicated convenience of use. The faculty teaching web courses had an increased workload, but 80.4% of them were satisfied or very satisfied, and 93.6% of them would probably or definitely teach another web-based course. They reported that the main negative on-line aspects were time demands (44%), technical problems (38%), and student problems, mostly with accessing the course content or communicating with the instructor. The authors concluded that 'measuring the success of on-line teaching and learning is complex procedure nested in series of intricate interactions' (p.31), and that 'outcome comparisons associated with

web-based learning and traditional on-campus education may be intuitively appealing, but they do not facilitate responsive programs.'

Hartman, Dziuban, and Moskal (1999) in their conclusion inducted that 'faculty satisfaction and student outcomes covary when predicting success in ALN (Asynchronous Learning Network) programs'. This has implications for this thesis because SS3011 course was taught in learning environment very close to ALN as the authors of the article defined it, and because the instructor of the course also represented important source of data in this thesis research.

Alliger, Tannenbaum, Bennet, Traver, and Shotland (1997) conducted meta-analysis of 34 studies and found utility-type reaction measures be more strongly related to learning than affective-type reaction measures. This finding has direct implications for evaluation of training effectiveness.

Another important paper is an article by Tannenbaum, Mathieu, Salas, and Cannon-Bowers (1991), where authors found support for their hypotheses that training fulfillment, trainee reactions, and training performance are related to post-training organizational commitment, academic self-efficacy, physical self-efficacy, and training motivation. The authors provide (p. 759) Bandura's definition of self-efficacy as 'the belief in one's capability to perform a specific task'. The authors added that self-efficacy is also related to an individual's openness to experiment and to the likelihood of using new technology. Another factor discussed in their article was organizational commitment. They defined it as the relative strength of an individual's identification with and involvement in a particular organization.

Hill, Smith, and Mann (1987) investigated the relation between sense of efficacy regarding computers and people's readiness to use them. They showed expected relation between efficacy beliefs with respect to computers and the likelihood of using computers. Also, they found previous experience with computers is related to beliefs of efficacy with respect to computers. However, the latter did not exert a direct independent influence on the decision to use computers. They concluded that their studies demonstrated the importance of efficacy in the decision to adopt an innovation – it is an important factor in determining an individual's decision to use an innovation. Experience per se, they say (p. 313), does not directly affect subsequent behavior regarding further adoption of computer technology. Rather, experience with computer technology leads to a higher likelihood of technology adoption only through changes in perceived efficacy. However, because the students in this sample are officers of U.S. services in contemporary circumstances, they do not have much choice about using or not using computers; it is everyday need.

D. STUDENT BEHAVIOR PATTERNS ON-LINE

William A. Long's theory of reactive behavior is described in several articles: Long (1985), Dziuban and Dziuban (1997), and Dziuban, Moskal, and Dziuban (1999).

In brief, it is a theory based on normal behavior patterns that adolescents exhibit in a learning environment, explaining how young people react to their environment and its associated stresses. According to Long, individuals tend to one of four behavior types, combined with zero to four ancillary traits. Four types of reactive behavior patterns are:

- **Aggressive Independent (AI).** These students tend: to have high energy level and little need for peer or teacher/instructor approval; to lack judgment, express their thoughts and feelings impulsively; to be disorganized and nonlinear, preferring to work independently, often in leadership positions. They are challenging students, preventing

instructor's complacency. Confrontation resolves their ambiguity, stress, or indecision.

- Aggressive Dependent (AD). These students are high achievers, usually very active in student organizations, honor courses, etc. They are non-confrontational, eager to please, participate in class.
- Passive Independent (PI). These students can be non-communicative, non-participatory, and stubborn. Even if having superior abilities, they may behave contrary to their own best interests.
- Passive Dependent (PD). They are affectionate, sensitive, non-confrontational, and extremely compliant. Their need for approval is high, dominates their relations with peers and with instructor. They see disagreements and criticism as personal rejection. When mature, they can become very caring and gentle persons.

According to Long's theory and many empirical findings, any of these four reactive behavior patterns is associated with none or any combination of next four ancillary traits (descriptions derived from Dziuban, Moskal, and Dziuban [1999]):

- Phobic Trait. These students tend to develop focused fears concerning possible undesired outcomes of their academic learning process; they are cautious decision makers, but excellent students in analytical situations.
- Impulsive Trait. They are erratic and capricious, adding vitality and energy to the classroom. They tend to answer a question before it is completely asked, or to undertake an on-line course before technical requirements are met.
- Obsessive-Compulsive Trait. These students are thorough, methodical, and careful, very organized. They strongly tend to succeed in completing their tasks and they enjoy academic achievement and excellence, but may lack spontaneity.
- Hysterical Trait. These students are creative, helpful, compassionate, and dramatic. They may create contagious energy and enthusiasm in classroom environment, but in crises they become chaotic and may fail in their assignments.

Long and other researchers confirmed the validity of this theory in several studies, including studies of congruence of parents and teachers, studies of predicting types and traits of students from teachers' perception of their academic problems, studies of the

correspondence of phenomenological and self-report approaches, etc. All these types and traits are present in normal population of students, so the theory has instructional utility in higher education.

Dziuban, Moskal, and Dziuban (1999) found indications that students in on-line courses tended not to be independent learners. Furthermore, passive dependent students, who are usually rather observers than participants, reacted least favorably to on-line courses. The authors also suggest directions for further research and conclude that lack of understanding and evaluation of described types of reactive behavior patterns may unknowingly discourage significant segments of student population from enrolling in distributed learning programs. Commenting on this finding, Dziuban and others (2000) concluded: 'The virtual environment is one in which students must reevaluate their fundamental approach to learning'.

III. METHODOLOGY

The organization of this chapter is as follows:

- Case Analysis
- Demographic Data & Biographies
- Questionnaires On-Line
- Student Tracking, Student Profiles, and Pages Tracking
- Grades
- Student Opinion Forms (SOFs)
- Interviews with the Students
- Interviews with the Instructor

The initial idea for this thesis was triggered during preparations for the first on-line delivery of the course 'Space Systems – Technology and Applications' (course code SS3011), taught during summer quarter of academic year 2000 at the Naval Postgraduate School (NPS) in Monterey, California. Commander Sue Higgins, US Navy, the instructor of this course, was previously trained at the University of Central Florida (UCF), Orlando, Florida, so the resulting teaching/learning during the course process could be interpreted as an application of 'UCF-model of distributed learning' to one course at NPS. Furthermore, UCF provided continuous support during the preparations for and during the course in hardware (servers), software (maintaining the web pages and forums, removing 'bugs', and necessary technical troubleshooting and help), and in other ways (occasional meetings, consultations, etc.).

A. CASE ANALYSIS

Case study by definition means a conceptual umbrella for multiple sub studies of an isolated example (Yin, 1993, p. xii), which is to say that different sources of data are

gathered. Ultimately, this thesis focuses on describing and analyzing qualitative data, but the organization of the course and of this research enabled the collection of significant amount of quantitative data. This case study is composed of several sub-studies based on:

- o Basics on-line questionnaire
- o A-2 questionnaire
- o Module 14 questionnaire
- o Final Survey questionnaire
- o On-line tracking data
- o Interviews with the students
- o Interviews with the instructor
- o Final grades

All these sub-studies are combined and integrated with the primary and secondary research questions.

The organization of the case study was dictated by the dynamics of the course and methods applied, i.e. the researcher had to adapt to the teaching schedule of the course to avoid any interference.

The four evaluation instruments were put on-line at appropriate times, according to targeted parts of the course or modules that I wanted to evaluate.

The instructor and I made clear the purpose of the thesis to the students on several occasions. The instructor introduced me to the students during the first class, so they could become familiar with me and with the research I planned to conduct.

I organized the interviews with the students individually several weeks after the course when exams and final papers from their other courses were completed. I used that time because they were free of other academic pressures, so they could be more relaxed, objective, and willing to be frank and vocal during the interviews.

Finally, I interviewed the instructor: before, during, and after the course. These latter occasions were much more directed by my observations, by questions that appeared from other data, or by her opinion of what else was important but still not mentioned.

Some of the instruments used in this research called for anonymous responses, and some were associated with student identity (names). Consequently, it was possible to explore relations between variables from different instruments (qualitatively and quantitatively), including measures of association (for instance coefficient of rank correlation). Such identifiable sources of data in this research were:

- o The Basics – Demographics and Studying Strategies (A-1) on-line questionnaire
- o Module 14 Evaluation
- o Biographies (all except two students posted them to forum, as the instructor requested in order to enable the students to get know each other)
- o Student Tracking, Student Profiles, and Pages Tracking. WebCT software was set to automatically track for each student the number of visits to web pages, number of read articles in forums, number of posts to forums, and additional data.
- o Grades
- o Individual interviews

It was not possible to associate other questionnaires (*After-orientation Questionnaire (A-2) and Final Survey*) with student identity, so analysis of responses may only be made in the distribution of the answers, of associations of variables within the instruments, and in qualitative analysis. One of the main reasons for this limitation was the way the WebCT software was set. As measures of association, I used two different coefficients of correlation, depending on whether a variable was numeric or ordered categorically:

Spearman's Rho (ρ) coefficient of rank correlation is applicable with ordered categorical variables and with a given sample size. Some other indicators (based on χ^2 and some others) could be used too. The equation for calculating the Rho coefficient is shown in Equation 1.

$$\rho = \frac{\sum_{i=1}^n R(X_i)R(Y_i) - n\left(\frac{n+1}{2}\right)^2}{\left(\sum_{i=1}^n R(X_i)^2 - n\left(\frac{n+1}{2}\right)^2\right)^{\frac{1}{2}} \left(\sum_{i=1}^n R(Y_i)^2 - n\left(\frac{n+1}{2}\right)^2\right)^{\frac{1}{2}}}$$

Equation 1. Spearman's Rho Coefficient of Rank Correlation [From: Conover (1999), p. 315].

For numerical variables, Pearson's coefficient of correlations was calculated:

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^n (x_i - \bar{x})^2} \sqrt{\sum_{i=1}^n (y_i - \bar{y})^2}}$$

Equation 2. Pearson's r Coefficient of Correlation [From: Berk & Carrey (2000), p. 321].

For both coefficients I provided respective **p**-values. In calculating **p**-value for each of the coefficients, the null-hypothesis (H_0) is that variables in the questions are mutually independent, while alternative hypothesis (H_a) finds a tendency either for the larger values of X_i to be paired with the larger values of Y_i , or a tendency for smaller values of X_i to be paired with the larger values of Y_i in which case, the coefficient would have negative sign. Due to the small sample in this research, a **p**-value of 0.05 would be acceptable as statistically significant.

B. DEMOGRAPHIC DATA

Only selected demographic data were collected, mostly within the first on-line questionnaire (see next section). Not all data from this set is applicable to this thesis, so part of these data is reported in Appendix F. Distributions and other relations are explored in Chapter IV.

C. QUESTIONNAIRES ON LINE

Thirty-two students attended SS3011, but only thirty of them completed it as regular NPS students: two of them were not regular NPS students and they were not getting credit for finishing the course. Moreover, they were off campus as non-resident additional attendees of the course and were treated differently from the other students. For these reasons, they are excluded from the sample.

Four on-line questionnaires were administered to the students (Appendices A through D). The instructor's support staff from the Training System Division, Naval Air Warfare Center, Orlando, Florida, provided the initial set of questions, but many items were adapted and modified. Also, a significant number of new questions were created because of the needs of the instructor and the research questions for this thesis. A new instrument was incorporated into the last questionnaire: Long-Dziuban's instrument with slightly modified instructions. The authors approved its application in this thesis. The four questionnaires were:

- *The Basics – Demographics and Studying Strategies (A-1)*. This instrument covered general facts about the students, but focused mostly on what the instructor was interested in order to know her students better. Besides questions about e-mail address, student status, service, pay grade and MOS, there are also questions about previous experiences relevant for attending the course (former space-related duties or courses attended, experience in using web resources), about expectations (expected number of web visits weekly, overall expectation on the on-line course), self-perceived proficiency in using computers (proficiency in using computers,

on-line research techniques), and concern about one's own ability to use the web-based materials in the class. The questionnaire also provided the students an opportunity to make comments in their own words. It was put online at the end of first module. It had a total of 25 items.

- *After-orientation Questionnaire (A-2)*. This instrument contained 26 items. It was directed towards the students' comfort level on various aspects of the course, and was administered after the first two weeks of the course. For instance, the students were asked about setting-up their systems, accessing the Internet, word processing, posting to forums, sending e-mail, using WebCT software, on technical support, and so on. Also, they had several items where they could respond in their own words and comment on different issues about their first two weeks of the course. Several questions explicitly asked them about their comfort level with the most important course features, like forums, e-mail, quizzes, links, and others.
- *Module 14 Evaluation* was applied after the fourteenth module. Module 14 was especially interesting for two reasons. First, it was different from other modules, and therefore, deserved special attention. Second, that point in time was close to the end of the course, so it was a very good moment to ask the students overall questions about the course. This questionnaire was the shortest (only 14 items), and there were three main groups of questions:
 - o Questions directly related to previously specified learning objectives (about abilities to identify key elements in Space Control, abilities to synthesize others' findings in forums, readiness to interact with subject matter expert in the area, etc.).
 - o Questions about final comfort level in accessing the Internet, sending e-mail, and posting comments to forums.
 - o Open-ended question to provide comments and additional thoughts.
- *The Final Survey* was applied after the final exam/paper, but before the students received their final grades for the course. It had 34 questions and contained the following groups of items:
 - o Questions the instructor found very interested, especially in the context of the ultimate learning objectives of the course.
 - o Questions about the perceived usefulness of several features used during the course (guidelines at the course homepage, quizzes, module readings, textbook readings, integration of responses to forums).
 - o Questions about affective reactions (liked/disliked) to several features.
 - o Open-ended questions about the instructional strategies and materials, usability of everything they learned in the course, flexibility, fundamental changes in the approach to learning, and similar topics.

- o Four questions about the interactivity as an important aspect of the learning process.
- o Long-Dziuban's on-line reactive patterns instrument

Though it may seem that four on-line questionnaires during the course took too much of the students' time, data about the time the students actually spent in answering the questionnaires clearly show that it was not the case. At most they needed between three and five minutes per questionnaire, and the majority of them chose to answer all or almost all of the questionnaires.

Thirty of the students answered the first questionnaire; thirty-one the second one; twenty-six the third questionnaire; twenty-one answered the *Final Survey* questionnaire.

D. STUDENT TRACKING, STUDENT PROFILES, AND PAGES TRACKING

WebCT software had installed a system of tracking student on-line activities:

- o Total number of visits to the course pages (also called total number of hits)
- o Total number of visits to the course homepage
- o Total number of visits to the course content page
- o Total number of forum articles (posts) read
- o Total number of forum articles (posts) posted
- o Total number of original forum articles posted (i.e. not as responses to someone's other posts)
- o Total number of follow-up forum articles posted (i.e. as responses to someone's other posts)
- o Date and time of posting (for each forum post)
- o Number of different course pages visited

E. STUDENT OPINION FORM (SOFS)

Student Opinion Forms are the standardized and mandatory formal way of obtaining feedback for any course taught at NPS. They are being applied not only in order to evaluate student perception of instructor and course effectiveness, but also as an

additional help and support to the instructor's efforts in improving the course, the methods of instruction, and other important aspects of teaching.

SOFs are always applied anonymously on forms that an equipped computerized system can read. The current version of SOF forms in use is NPS 5040/2 (REV 3-84)]. Besides elementary data about the course, on the student's curriculum, the number of hours during the quarter the student attended, and the number of quarters already completed, there were 16 questions about the course, the quality of teaching, the exams, the textbook, and similar topics. Students answer all 16 questions on a scale from 5 to 0 (from 'strongly agree' to 'strongly disagree, including a category for 'no comment'). It was easy to quantitatively analyze student feedback, but an appropriate qualitative analysis of student responses can also lead to qualitative conclusions about the overall success of the course.

F. GRADES

The instructor provided a list of final grades for all SS3011 students who successfully completed the course. The analyses include these data.

G. INTERVIEWS WITH THE STUDENTS

In the beginning of the course, the instructor introduced me to the students and explained the goals of this research. Near the end of the course, the instructor sent an e-mail to the students announcing I would like to conduct brief, post-course individual interviews with the students who voluntarily chose to participate. Then, I sent individual e-mail messages to each of them.

I prepared eleven open-ended questions (Appendix E). As a clinical psychologist with experience in hundreds of individual interviews, questionnaires, and other research methods with military officers and enlisted personnel, I planned to keep the interviews

focused on questions and to intervene minimally, only when it was necessary to redirect their comments and explanations back to the questions. I intended to encourage the students to talk frankly and to feel free to give critiques, recommendations, and suggestions concerning the on-line course.

The most interesting and intriguing responses and comments from the four on-line questionnaires, and dilemmas I expected in the discussion of the research questions primarily inspired the choice of these interview questions.

I decided to conduct the interviews one to two months after the course was completed so they would not feel pressure from other final exams or written assignments and be more or less free from the 'fresh' impressions of their final grade in SS3011.

H. INTERVIEWS WITH THE INSTRUCTOR

I had over fifteen formal and informal meetings with the instructor. I listed areas and prepared questions, which I then I sent to her several days before the arranged interviews, for the purpose of direct collection of facts, her opinions, interpretations, and comments on relevant course issues. The interviews were conducted without a third party present and in a pleasant office atmosphere. I took notes as the instructor answered the questions and added comments.

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IV. RESULTS AND DATA ANALYSIS

In this chapter I provide data I collected using all instruments in this research: four on-line questionnaires, Student Opinion Forms, student on-line tracking, final grades, and interviews with the students and with the instructor. Besides that, I made the appropriate data analysis, mostly concentrating on three key points: distributions of the responses/data, degree of association between different variables (in terms of coefficients of correlation or rank correlation), and qualitative analysis of responses to open-ended questions or interview questions. Data not relevant to research questions are omitted or moved to Appendix F. After each section, I provide a summary of the data analysis in the respective section and a brief discussion. Integration of all results and overall discussion appears in Chapter V.

A. QUESTIONNAIRES ON-LINE

1. First questionnaire – ‘THE BASICS, Your Demographics and Studying Strategies’

The first question (Appendix A) was about student e-mail addresses, and secondly about their status as a NPS student. All students were full-time NPS students. The number of valid responses was thirty.

Table 1 shows students by service.

Service	Number of students	Percent (%)
US Marine Corps	13	43.34
US Navy	10	33.33
US Army	4	13.33
US Air Force	0	0.00
Others	3	10.00
Total	30	100.00

Table 1. Students in the Sample by Service.

Thirteen officers (43.33%) were Marine Corps officers, one third were Navy officers, and three were US Army officers . There were no Air Force officers, and the service of the others was not specified.

Table 2 below shows the distribution of the students by pay grade (not rank).

Pay Grade	Number of Students	Percent (%)
O-3	18	60.00
O-4	10	33.33
O-5	1	3.33
Not available	1	3.33
Total	30	100.00

Table 2. Students in the Sample by Pay Grade.

Since pay grade is an ordered categorical category (except where datum on pay grade was not available), it is possible to check its possible associations with other numerical or ordered categorical variables – not only with such variables in the first questionnaire, but also in the Module 14 questionnaire (which was also identifiable by student's name) and in student on-line tracking variables.

Statistical indicators like the mean or standard deviation would not be appropriate here because responses to these statements are ordered as categorical variables where semantic distances between categories are only artificially assumed to be equal. Only nonparametric statistical methods are applicable because the assumption about normal distribution does not have any justification in this situation. Also, the sample is very small.

For pay grade, only one rank correlation coefficient was statistically significant (Table 3).

Instrument	Statement	ρ	p value
First questionnaire	'Have you experienced an on-line course (or courses) that used a web site to do/complete coursework?'	0.404	0.027

Table 3. Significant Correlation and Level of Significance between Student Pay Grade and Another Variable .

Students with a higher pay grade (i.e. with higher rank) tended to have significantly more previous on-line experience.

The eighth item the students were asked was about the number of quarters they had been enrolled, including the current quarter. Their responses are analyzed in Table 4.

Quarters completed	Number of students	Percent (%)
None	1 ²	3.33
One	3	10.00
Four	17	56.67
Five	8	26.67
Six	1	3.33
Total	30	100.00

Table 4. Students in the Sample by Number of Quarters Enrolled (Including Current Quarter).

Three student tracking variables had significant correlations with the number of quarters enrolled. Since all these variables were numerical, I used Pearson's r coefficient of correlation. Table 5 shows significant correlations.

² This student probably didn't understand the question, because it asked for number of quarters enrolled *including* current quarter. Other data showed that all students in the sample had status of regular NPS student.

Instrument	Variable	r	p value
Student tracking	Number of visits to the course homepage.	-0.479	0.007
Student tracking	Number of posts to the forums.	-0.432	0.017
Student tracking	Number of follow-up posts to the forums.	-0.388	0.034

Table 5. Significant Correlations and Levels of Significance between the Number of Quarters Enrolled and Other Variables (Ordered by Significance).

Senior NPS students (those enrolled in their fourth to the sixth quarter) slightly, but statistically significantly, tended to visit the course homepage fewer times, to post fewer forum articles, and fewer follow-up posts to the forums.

Asked about previous space tours/duties, only two students responded they had 'some training'. One responded he had several programs, and all other students none.

The next question was about previously attending any other space-related course(s). Only one student had attended one such course, and all the others none.

Asked about previously attending any on-line courses, only three students responded they had such experience. One of them was actually attending an MBA program on-line.

The eighteenth item was about the expected frequency of using the course web site. The responses are shown in Table 6.

Expected frequency	Number of students	Percent (%)
3-5 times per week	23	76.66
2 times a week	2	6.67
At least once a week	2	6.67
'I don't know'	3	10.00
Total	30	100.00

Table 6. Expected Frequency of Using the Course Web Site.

This variable has significant correlation to only one variable: the number of original postings made by the student in forums (student tracking). Spearman's ρ is 0.423, p is 0.020. The students with a higher than expected frequency of accesses tended to send more postings to forums during the course.

The next item the students were asked was about where they plan to use access to the course the most. Table 7 shows the responses. This is a non-ordered categorical variable, so rank correlation is not applicable. One half of the students planned to access the course from their homes, which indicates they intended to use the convenience of accessing the on-line course from a place other than the school.

Location	Number of Students	Percent (%)
BOQ room	0	0.00
A house	15 ³	50.00
Computer lab in campus	14	46.67
Library in campus	1	3.33
Shared area in living quarters	0	0.00
Others	0	0.00
Total	30	100.00

Table 7. Location that Students Expect to Use the Most to Access the Course.

The next question asked the students about their self-perceived level of computer proficiency: 'On a scale of 1 to 5, where 1 = novice and 5 = expert, how would you rate your current proficiency in using computers'? Figure 6 shows the distribution of the responses. Most of the students (seventeen or 56.67%) perceived themselves at a proficiency level between 'medium' and 'expert'. Only one student chose a response between 'novice' and 'medium'. This variable showed statistically significant correlation with three other variables (Table 8).

³ One student added, answering the following question – 'possibly at school in one of the labs'.

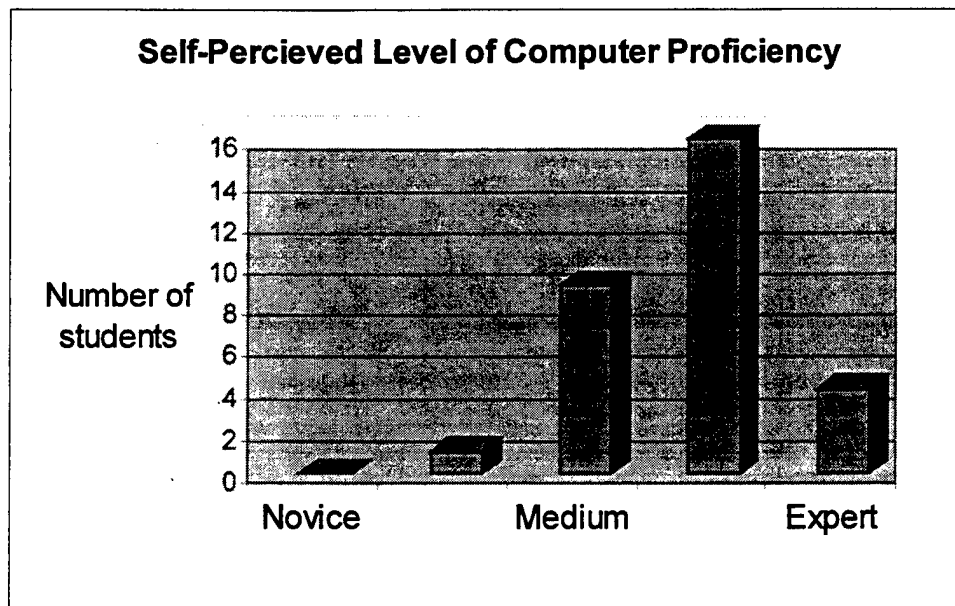


Figure 6. Distribution of Self-Perceived Computer Proficiency.

N = 30 Mean = 3.77 Median = 4
 Minimum = 2 Maximum = 5 Mode = 4

Instrument	Statement	ρ	P value
First questionnaire	'On a scale of 1 to 5 where 1=novice and 5=expert, how would you rate your on-line search resources and techniques?'	0.836	< 0.001
First questionnaire	'Please indicate the extent to which you agree with the following statement: I expect this online course will be valuable and improve my learning:' [1=strongly disagree ... 5=strongly agree]	-0.498	0.005
Student tracking	Number of articles read	0.425	0.019

Table 8. Significant Correlations and Levels of Significance between Self-Perceived Computer Proficiency and Other Variables (Ordered by Significance).

Students who perceived themselves as more computer proficient strongly tended to perceive themselves as better in using on-line search resources and techniques. The second relation (a much weaker correlation than the first one) means that students who perceive themselves as more computer proficient expected to gain and learn less from

this on-line course than students who perceive themselves as not very computer proficient. The third relation shows that the students who perceived themselves as more computer proficient tended to read more articles in the course forums. They probably found the forums easier, more comfortable, less distractible, could pay more attention to the articles, and/or tend to be more active in reading the forums articles.

The next question in the first questionnaire was about self-perceived on-line searching skills: 'On a scale of 1 to 5 where 1=novice and 5=expert, how would you rate your on-line search resources and techniques?' Figure 7 shows the distribution of the responses. Fourteen students (46.67%) saw themselves as between 'medium' and 'expert', nine students (30.00%) as 'medium', while only four students (13.33%) thought they were between 'novice' and 'medium' in search techniques.

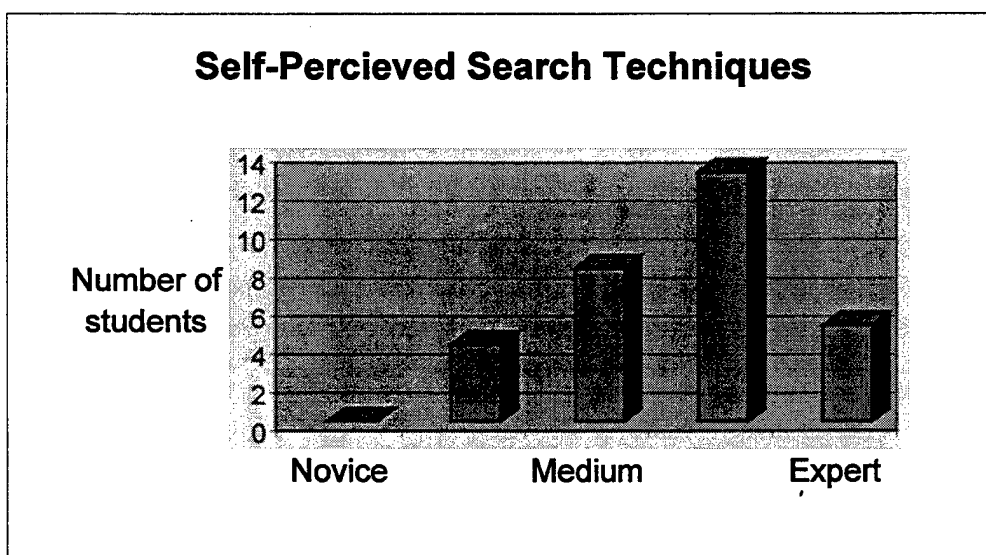


Figure 7. Distribution of Self-Perceived On-Line Search Skills.

N = 30	Mean = 3.63	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

Five correlations with other variables were significant (Table 9).

Instrument	Statement	ρ	p value
First questionnaire	'On a scale of 1 to 5, where 1 = novice and 5 = expert, how would you rate your current proficiency in using computers.'	0.836	< 0.001
Student tracking	Number of different pages visited	-0.404	0.027
Module 14	'Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.' [1 = strongly disagree ... 7 = strongly agree]	0.398	0.030
First questionnaire	'Please indicate the extent to which you agree with the following statement: 'I expect this online course will be valuable and improve my learning' [1=strongly disagree ... 5=strongly agree]	-0.368	0.045
Module 14	'Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum.' [1 = strongly disagree ... 7 = strongly agree]	0.367	0.046

Table 9. Significant Correlations and Levels of Significance between Self-Perceived On-Line Search Skills and Other Variables (Ordered by Level of Significance).

The first relation, the only high correlation to other variables, means that students who saw themselves as more computer proficient strongly tended to use on-line search techniques better. The second relation is also logical: students who think of themselves as skilled in on-line search techniques expect to gain less from the course (in terms of valuable improvements in their learning), while students with less on-line experience and skill expect to gain more because of the on-line nature of the course.

The relations with items from the Module 14 questionnaire are hard to explain. Possibly, students with high on-line search skills (by their own assessment) later in the course achieved more in the sense of the course learning objective described in the respective question. It is interesting that the students with higher level search skills tended to visit a smaller number of course pages. A possible explanation would be that

they were able to get to pages they wanted to visit easier, as opposed to students less skilled in search techniques, who had to use the 'longer way' and thus visited more different pages in order to get what they wanted from the course web site.

The next scale was about the self-perceived expectations of improvement that the course would provide in terms of their learning techniques: 'Please indicate the extent to which you agree with the following statement: I expect this on-line course will be valuable and improve my learning.' Figure 8 shows the distribution of the responses.

Over 73% students expected the on-line course to improve their learning ('somewhat' or 'strongly'), and only two of them disagreed with that statement. This variable had five significant correlations (Table 10). Correlations with other variables in this questionnaire are telling us that more experienced and skilled students expect to gain less from the course. The only conclusion to make about the other three correlations is that expectations on learning improvement are somewhat associated with self-assessed achievements in meeting learning objectives of Module 14.

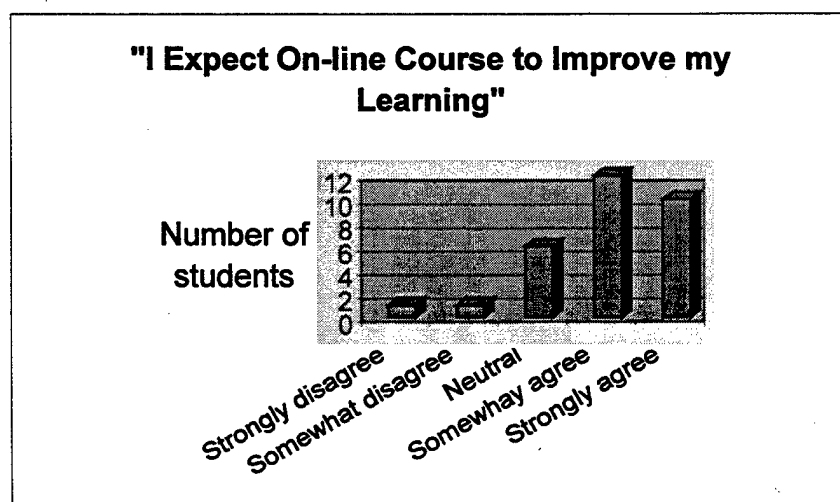


Figure 8. Distribution of Expected Learning Improvement.

N = 30 Mean = 3.97 Median = 4
Minimum = 1 Maximum = 5 Mode = 4

Instrument	Statement	ρ	p value
First questionnaire	'How would you rate your current proficiency in using computers?'	-0.498	0.005
Module 14	'Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems.'	0.452	0.012
Module 14	'Identifying key elements of Space Control.'	0.405	0.026
Module 14	'Participating in forums (e.g. discussing, identifying/ consulting subject matter experts), to evaluate space control issues.'	0.392	0.032
First questionnaire	'How would you rate your on-line search resources and techniques?'	-0.368	0.045

Table 10. Significant Correlations and Levels of Significance between Expected Learning Improvement and Other Variables (Ordered by Level of Significance).

The next item asked students about their concerns about the course: 'I am concerned about my ability to use the web-based materials in this class'. The distribution of the responses is shown in Figure 9. This question was set in an inverted direction: more desirable responses are on the left side of the scale. Sixteen students (53.33%) strongly disagreed with the statements, i.e. they were not concerned about their abilities to use the web-based materials at all. However, five students (16.67%) stated they were 'somewhat concerned', and eight (26.67%) chose neutral response.

Only three correlations between this statement and other variables were significant (Table 11). I expected the first two relations: students who are more proficient in using computers and more skilled in searching on-line are less concerned about their own abilities of using web materials in the course. The third correlation shows that more concerned students saw Module 14 material less useful to them in attaining high achievement in the forums discussions on space control issues. The question asked

students how the material presented in their module enabled them to achieve the respective learning objectives.

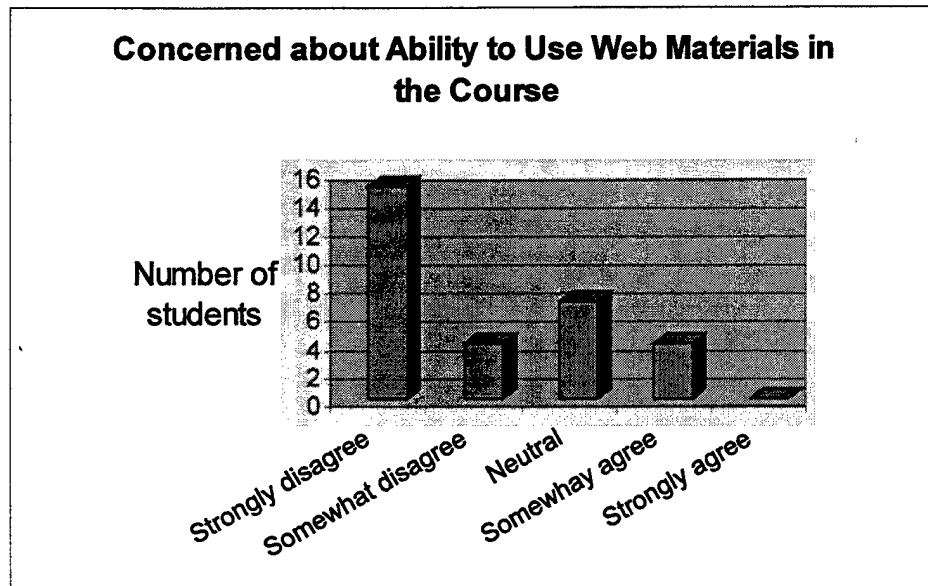


Figure 9. Distribution of Stated Concerns about Own Ability to Use Web Materials in the Course.

N = 30 Mean = 1.97 Median = 1
 Minimum = 1 Maximum = 4 Mode = 1

Instrument	Statement	ρ	p value
First questionnaire	'On a scale of 1 to 5, where 1 = novice and 5 = expert, how would you rate your current proficiency in using computers.'	-0.498	0.005
First questionnaire	'On a scale of 1 to 5 where 1=novice and 5=expert, how would you rate your on-line search resources and techniques?'	-0.368	0.045
Module 14	'Participating in forums (e.g. discussing, identifying/consulting subject matter experts), to evaluate space control issues.'	-0.364	0.048

Table 11. Significant Correlations and Levels of Significance between Concerns on Own Ability to Use Web Material in the Course and Other Variables (Ordered by Level of Significance).

This questionnaire ended with an open-ended opportunity for the students to add any comment: 'Any additional comments, concerns, or suggestions are welcome.'

Sixteen students (53.33%) added comments. Analyzing their responses, I grouped them into four typical kinds of comments: Positive first impressions, advice and recommendations, neutral comments, and concerns. Here are their responses:

Positive first impressions

- I like what I've seen so far!
- None for now other than site seems to be very user friendly and well developed.
- Looking forward to this quarter and learning environment.
- I'm looking forward to trying an on-line course!
- I was a bit skeptical, but so far the course seems to be going well. The thing I like best is the flexibility - I can read and take the quizzes when it is convenient for me. I worried that I might not keep up, but that has not been a problem.
- Great response times to technical problems. The format is very well designed and implemented.

Advice and recommendations

- Class sizes should be smaller or groups should be assigned earlier. The general forum is too large.

Neutral comments

- None, at this time. Looking forward to this first time experiment with use of online learning.
- None at this time. Good Survey!
- I have no idea how much time this class will take.
- I do prefer traditional in class teaching. Online course work requires more effort because of the all the keystroke required to complete a course. Verbal communications allows the student to quickly ask a question and get an answer. Spell checking is needed on these web pages to help speed up and reduce keystrokes.

- As this is my first web-based course, I am apprehensive. I prefer a more formal lecture style of learning. However, I will give this course my best effort.

Concerns

- I'm worried I'll spend more time trying to figure out this program than learning about space.
- I am concerned about potential computer and Internet related problems.
- That website access will be available when required and I won't have to continuously fight the system to get access is a concern.
- It seems that the server is having some capacity issues at peak times, i.e. during school hours. More often than not I am getting a 'page not available' image when I click on links or postings. Makes things aggravating, but not impossible. I can live with it, but those that chose #1 for questions #21 and #22 might be hurting.⁴

There were more positive and neutral responses than negative comments. There were also some other 'signals' from the students that deserve additional attention: comments that some of them personally simply prefer classroom (face-to-face) learning to on-line learning; that their concerns are about technology malfunctions, not about the DL course itself, and that class size and forums could be too large.

First questionnaire – Summary

This on-line questionnaire was designed to collect some general facts about the students and to collect data the instructor and I wanted to know from this group of students.

Thirty students completed the questionnaire. The questionnaire collected their e-mail addresses, data on their status as NPS students, their service (over 43% were

⁴ Answer #1 to questions 21 and 22 are students who identified themselves as novices in computer proficiency and in on-line search techniques. In this sample there were no such students.

Marines, one third were Navy officers, four were US Army, and three others), and pay grade (60% had O-3, one third O-4, and one O-5). Pay grade had significant rank correlation with previously experienced on-line course or courses, i.e., officers with a higher pay grade (higher rank) tended to have more experience with on-line courses. However, this was only a mild correlation.

The number of enrolled quarters varied from none to six, with a mean of 3.9. This variable had no significant correlations with any other variables, except with three student tracking variables: NPS students attending later quarters tended to visit the course homepage fewer times, to send fewer posts to forums, and fewer follow up posts to the forums.

Only two students had some previous space-related duties, and only one had taken previous space-related course. Three students had experience with an on-line course, including one who attended an MBA program on-line. Approximately half the students responded they would access the course web sites mostly from home, and another half mostly from computer lab in the campus.

Four five-point scales about self-perceived computer proficiency, on-line search skills, expectations to improve learning, and concerns about own abilities to use web-based materials in the course had some interesting correlations with each other, correlations with some data from on-line student tracking, and with several items from the Module 14 questionnaire. Between two and five students thought they had low computer proficiency, limited on-line search skills, or they had significant concerns about their own abilities to use web-based materials. Responses to the statement 'I expect this online course will be valuable and improve my learning' had negative correlation with

some other variables: the more a person knows about computers and the Internet, the less he/she expects to improve his/her learning in the course. It is important to note that 'improving one's own learning' is not same as 'learn in a course': the first refers to learning skills and habits, and the second to knowledge and skills in a subject matter.

Several tendencies can be concluded from the student comments: their feedback was more positive and neutral than negative; some of them just preferred a traditional classroom to an on-line course (without explicit explanation). The student concerns were more about technical problems than about the DL course itself. Some complained about the forums being too large.

2. Second Questionnaire – 'A-2'

This questionnaire (Appendix B) was anonymous. It was administered after the orientation part of the course, i.e., during the second and part of the third week of the course. Thirty-one students completed the A-2 on-line questionnaire, which means that besides resident NPS students, one or two of the non-resident students responded to the questionnaire. From a total of 26 questions/statements, 17 were in the form of five-point scales (from 'Extremely uncomfortable' to 'Extremely comfortable'), and the remaining questions were open-ended.

The first question was 'How would you rate your comfort level at this point with setting-up your system?' Figure 10 shows the distribution of the responses.

Clearly, majority of the students (twenty-seven out of thirty-one or 87.01%) did not have significant problems with setting-up their PC. Only four students said they were somewhat uncomfortable.

There were eight statistically significant rank correlations with other variables (Table 12).

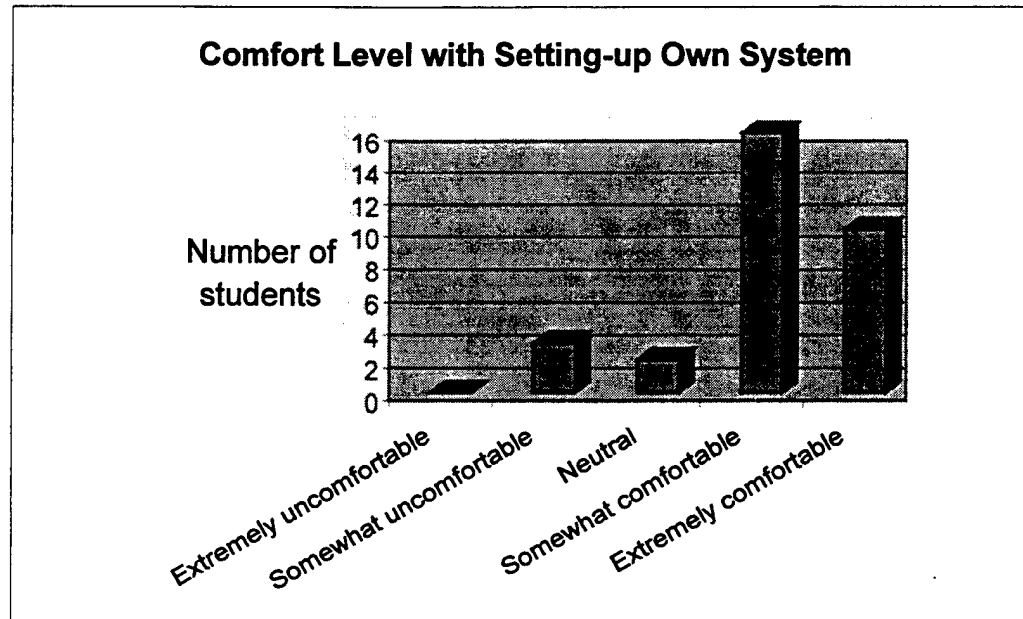


Figure 10. Distribution of Responses on the Comfort Level with Setting-up Own System.

N = 31	Mean = 4.06	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

The students who tended to have a lower comfort level with their PCs tended to have a lower comfort level with other technically demanding aspects of the course: using forums, posting to forums, sending e-mail, using word processing and accessing the Internet. Also, they tended to see some of the features the instructor provided the students to help them with the learning process as less effective than the others: 'Rules of engagement', course overview and course syllabus. 'Rules of engagement' was hypertext linked to the course homepage, with clearly stated expectations and standards the instructor had about student professionalism, course participation, studying, initiative, and academic level of communication. The course overview, written in the same media,

briefly defined the objectives and organization of the course. The content of the course syllabus (also written in hypertext) was self-explanatory.

Question	ρ	p value
'How would you rate your comfort level at this point with posting to the forum?'	0.692	< 0.001
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.614	< 0.001
'How would you rate your comfort level at this point with sending electronic mail?'	0.526	0.002
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.441	0.013
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.421	0.018
'How would you rate your comfort level at this point with word processing?'	0.409	0.022
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.401	0.026
'How would you rate your comfort level at this point with accessing the Internet?'	0.400	0.026

Table 12. Significant Correlations and Levels of Significance between the Comfort Level in Setting-up Own System and Other Variables (Ordered by Level of Significance).

The second question was: 'How would you rate your comfort level at this point with accessing the Internet?' The distribution of student responses is in Figure 11.

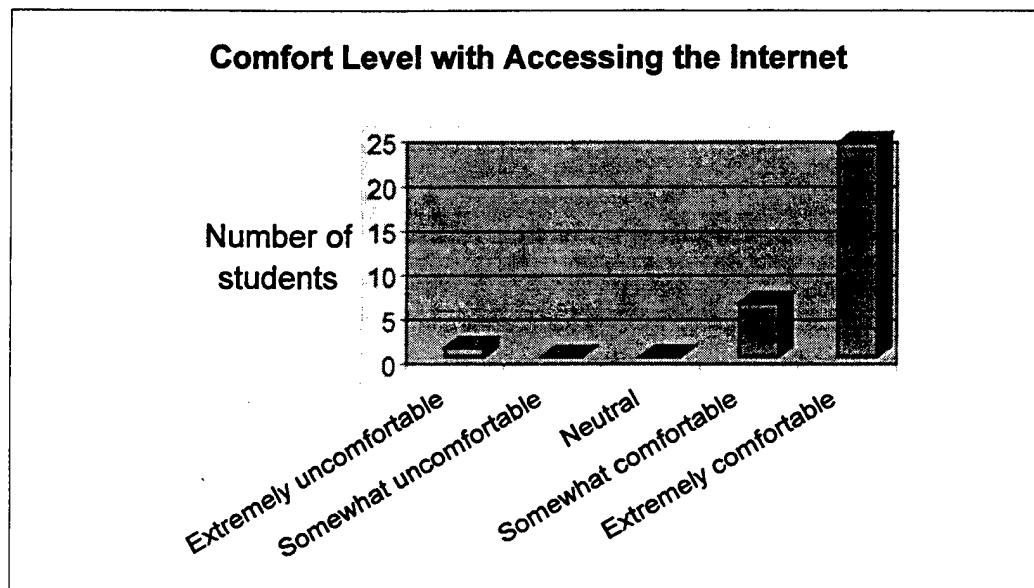


Figure 11. Distribution of Responses on the Comfort Level with Accessing the Internet.

N = 31	Mean = 4.68	Median = 5
Minimum = 1	Maximum = 5	Mode = 5

Clearly, the majority of the students (25 students or 80.65% responded 'extremely comfortable') were very comfortable in accessing the Internet. Only one had major problems, and six were more 'somewhat' than 'extremely' comfortable. Obviously, the students had relatively more problems in setting up their systems and their PCs than with getting on-line.

This variable showed statistically significant correlations with twelve out of sixteen other ordered categorical variables in the questionnaire (Table 13).

The highest correlation this variable had is, surprisingly, with the comfort level in word processing. The students who easily used word processing strongly tended to easily access the Internet. The second highest correlation is the association with the comfort level in using the links feature in the course. Other correlations are not so high, but they

certainly indicate that the comfort level in accessing the Internet is very indicative of the overall comfort level a student expressed about different aspects of the DL course.

Question	ρ	p value
'How would you rate your comfort level at this point with word processing?'	0.737	< 0.001
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.728	< 0.001
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.587	0.001
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.581	0.001
'How would you rate your comfort level at this point with posting to the forum?'	0.571	0.001
'How would you rate your comfort level at this point with sending electronic mail?'	0.529	0.002
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.477	0.007
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.451	0.011
'How effective were module objectives? That is, to what extent did the module objectives help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.406	0.023
'How would you rate your comfort level at this point with setting-up your system?'	0.400	0.026
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.399	0.026
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.398	0.027

Table 13. Significant Correlations and Levels of Significance between the Comfort Level in Accessing the Internet and Other Variables (Ordered by Level of Significance).

The word processing comfort level was the next question: 'How would you rate your comfort level at this point with word processing?' Figure 12 shows the distribution of the responses.

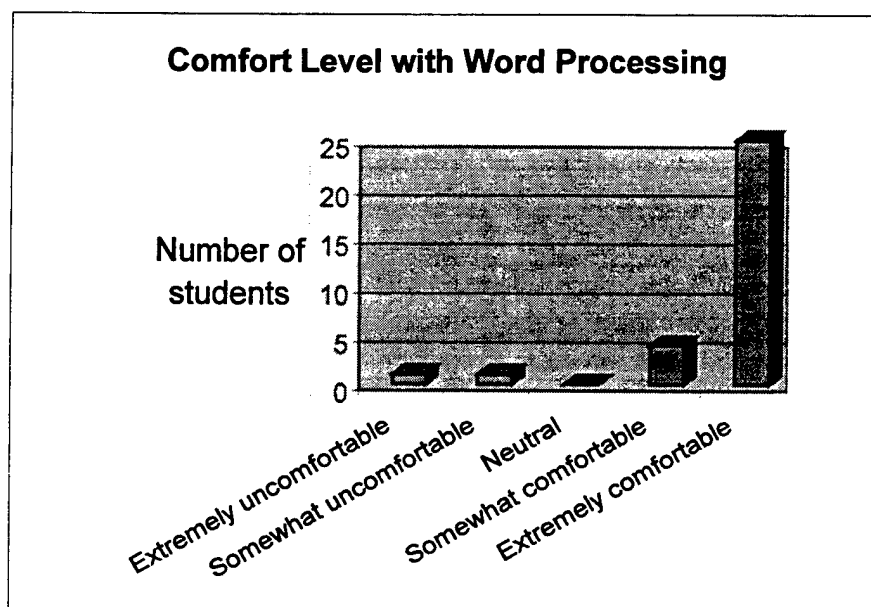


Figure 12. Distribution of Responses on the Comfort Level with Word Processing.

N = 31	Mean = 4.65	Median = 5
Minimum = 1	Maximum = 5	Mode = 5

Almost all students were very comfortable with word processing (85.65% responded 'extremely comfortable'). This is understandable because of the common usage of word processing in modern office work. Only two students had significant problems with word processing.

The word processing comfort level variable was significantly correlated with ten other variables in the questionnaire (Table 14). Similar to accessing the Internet comfort level variable, this variable seems to be very indicative of the overall comfort level with DL of a student in this course. The highest correlations are with the comfort level in sending electronic messages and with the comfort level in accessing the Internet. These

three variables are probably key indicators of how well a person is able to handle this kind of course in terms of the comfort level. Further analysis will show if there are any other variables with similar significance in this instrument.

Question	ρ	p value
'How would you rate your comfort level at this point with sending electronic mail?	0.780	< 0.001
'How would you rate your comfort level at this point with accessing the Internet?'	0.737	< 0.001
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.541	0.002
'How would you rate your comfort level at this point with posting to the forum?'	0.560	0.004
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.503	0.004
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.450	0.011
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.425	0.017
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.425	0.017
'How would you rate your comfort level at this point with setting-up your system?'	0.409	0.022
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.388	0.031

Table 14. Significant Correlations and Levels of Significance between the Comfort Level with Word Processing and Other Variables (Ordered by Level of Significance).

The fourth question addressed the forums: 'How would you rate your comfort level at this point with posting to the forum?' Figure 13 shows the distribution of the responses.

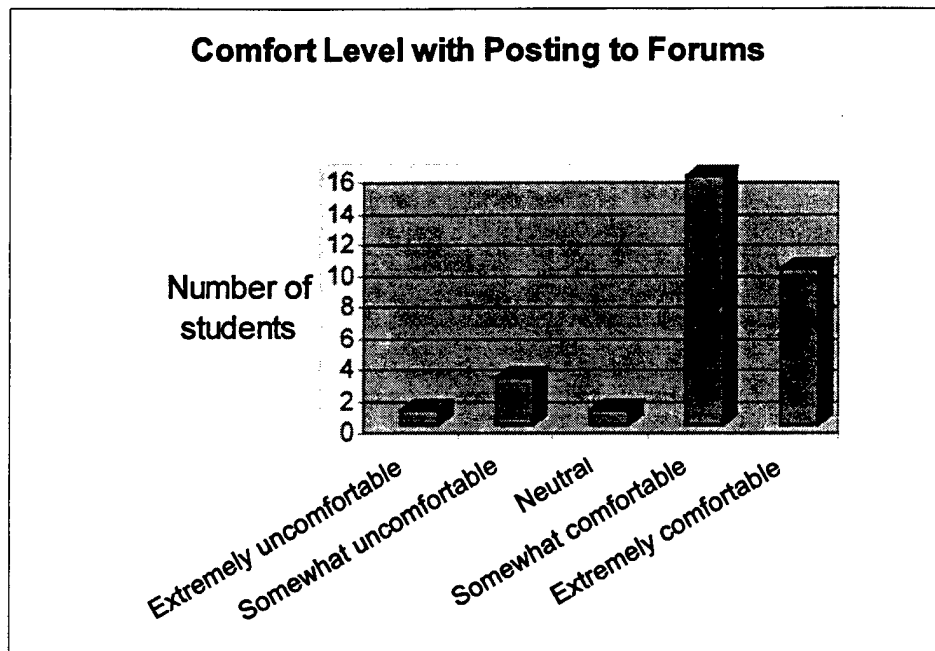


Figure 13. Distribution of Responses on the Comfort Level with Posting to the Forums.

N = 31	Mean = 4.00	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

A large majority (26 students or 83.87%) of students felt comfortable with posting to the forums, but more of them were 'somewhat comfortable' (16 students or 51.61%) than 'extremely comfortable' (10 students or 32.26%). Four students (12.90%) felt uncomfortable, and one was neutral about this issue.

Table 15 shows significant correlations. Two variables about the comfort level with two aspects of the forum used in the course are very highly correlated. Other correlations confirm that this variable is one of those central comfort level variables within a DL environment.

The fifth question was: 'How would you rate your comfort level at this point with sending electronic mail?' Figure 14 shows the distribution.

Question	ρ	p value
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.800	< 0.001
'How would you rate your comfort level at this point with setting-up your system?'	0.692	< 0.001
'How would you rate your comfort level at this point with accessing the Internet?'	0.571	0.001
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.537	0.002
'How would you rate your comfort level at this point with word processing?'	0.506	0.004
'How would you rate your comfort level at this point with sending electronic mail?'	0.491	0.005
'How would you rate your comfort level at this point with the technical support available to you through your Internet service provider (ISP)?'	0.489	0.005
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.464	0.009
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.456	0.010
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.445	0.012
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.422	0.018
'How would you rate your comfort level at this point with the technical support available to you on CD-ROM?'	0.410	0.022

Table 15. Significant Correlations and Levels of Significance between the Comfort Level with Posting to the Forums and Other Variables (Ordered by Level of Significance).

Twenty-five students (80.65%) felt extremely comfortable in sending e-mail, which is to be expected in the NPS environment since every student is expected to check e-mail frequently. Within the course context, e-mail was functioning well as one of the

key ways of communicating. However, few students had problems with sending e-mail: two (6.45%) felt 'extremely uncomfortable' and one (3.23%) 'somewhat uncomfortable'.

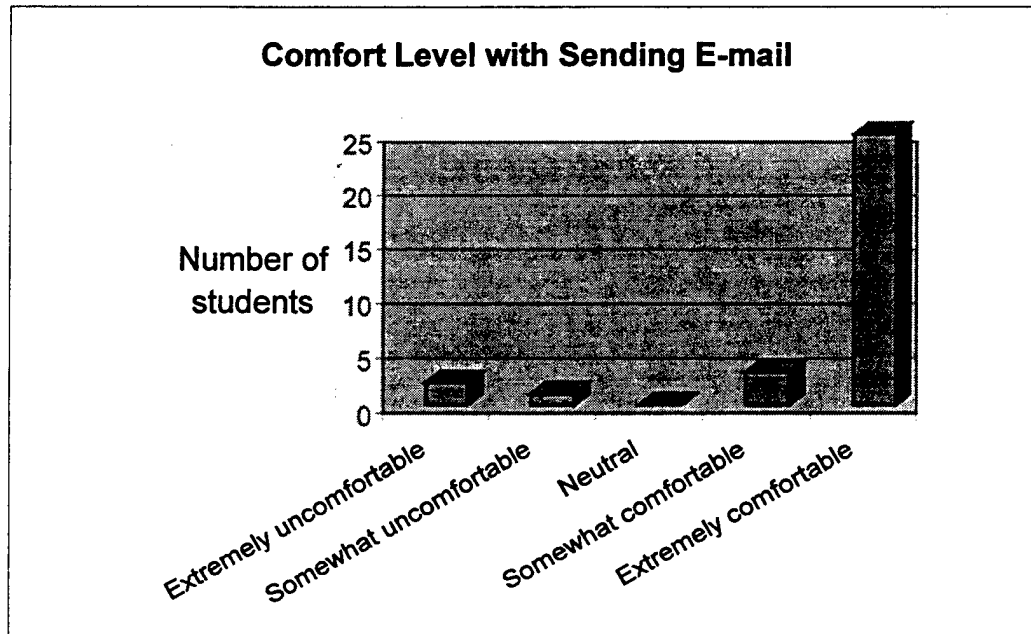


Figure 14. Distribution of Responses on the Comfort Level with Sending E-mail.

N = 31	Mean = 4.55	Median = 5
Minimum = 1	Maximum = 5	Mode = 5

This variable had ten significant correlations (Table 16).

The most significant is the correlation between the comfort level with sending e-mail and with word-processing. Other correlations, not as high as the first one, are with links usage, accessing the Internet, setting up the system, etc. This is the fifth of those 'core' comfort level variables.

Question	ρ	p value
'How would you rate your comfort level at this point with word processing?'	0.780	< 0.001
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.540	0.002
'How would you rate your comfort level at this point with accessing the Internet?'	0.529	0.002
'How would you rate your comfort level at this point with setting-up your system?'	0.526	0.002
How would you rate your comfort level at this point with posting to the forum?	0.491	0.005
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.439	0.013
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.434	0.015
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.415	0.020
How would you rate your comfort level at this point with the email feature being used to teach this course?	0.410	0.022
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.392	0.029

Table 16. Significant Correlations and Levels of Significance between the Comfort Level with Sending E-mail and Other Variables (Ordered by Level of Significance).

The next question was open-ended. It asked: 'In what areas of the on-line technologies (system set-up, accessing the internet, word-processing, posting to forums) do you still need help?' Twenty students answered 'None' and one who answered 'None, just practice.' I divided the other responses into two groups: 'Forum postings' and 'Other':

Forum Postings

- Post or replying to a comment in the Forum is still less than user friendly
- Posting to Forums
- The postings are still rough as well as the quizzes
- Posting to the forum is still hit or miss. In other words, I'm not confident that what I submit is going where I think I am sending it.
- Posting without losing work
- I am still getting run-time script errors when accessing postings

Other

- System set-up: advanced issues, troubleshooting
- Very confusing because of all bugs in this system. Thanks for the instructor's summary via email - this helped me stay on track.
- At this time was changing the subject type, but that has all been resolved.⁵

To conclude, the students' answers to this question indicated that problems with forum postings were most common, but the majority of them did not have significant problems with on-line technology that had been not solved when they answered the questionnaire.

The sixth comfort level scale was about software technical support: 'How would you rate your comfort level at this point with the technical support provided for using the WebCT software?' The distribution of the student responses can be seen in Figure 15.

⁵ This response is probably also related to forum posting issues.

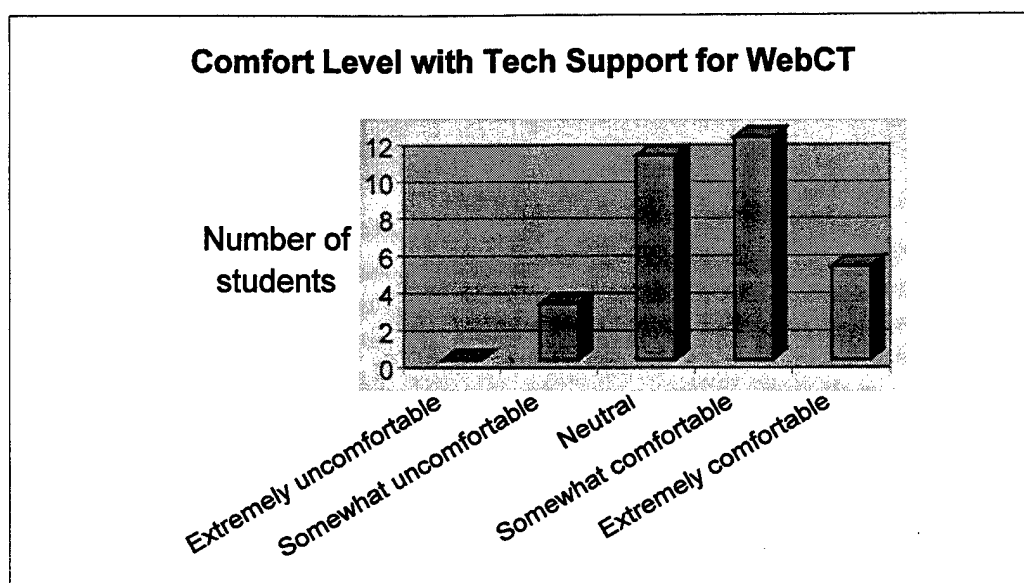


Figure 15. Distribution of Responses on Comfort Level with the Technical Support Provided for the WebCT Software.

N = 31	Mean = 3.61	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

A relatively large number of neutral answers (twelve or 38.71%) indicates many students did not need to use the technical support for the WebCT software. Those who needed that support were mostly 'somewhat' or 'extremely' comfortable, i.e., satisfied with the support provided. Only three students were 'somewhat uncomfortable', i.e., not satisfied with the technical support.

This variable is significantly correlated only with three other variables in the instrument (Table 17).

Question	ρ	p value
'How effective were module objectives? That is, to what extent did the module objectives help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.462	0.009
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.408	0.023
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.406	0.023

Table 17. Significant Correlations and Levels of Significance between the Comfort Level with the Technical Support Provided for the WebCT Software and Other Variables (Ordered by Level of Significance).

The students more satisfied with the technical software support tended to estimate some course features set by the instructor (module objectives and rules of engagement) as more effective (i.e., they had more utility and fewer difficulties with these features). The third relation shows that lower comfort level with technical software support was associated with lower comfort level with e-mail features in the course.

The tenth variable in the instrument asked the students the following: 'How would you rate your comfort level at this point with the technical support available to you through your Internet service provider (ISP)?' Figure 16 below shows their responses.

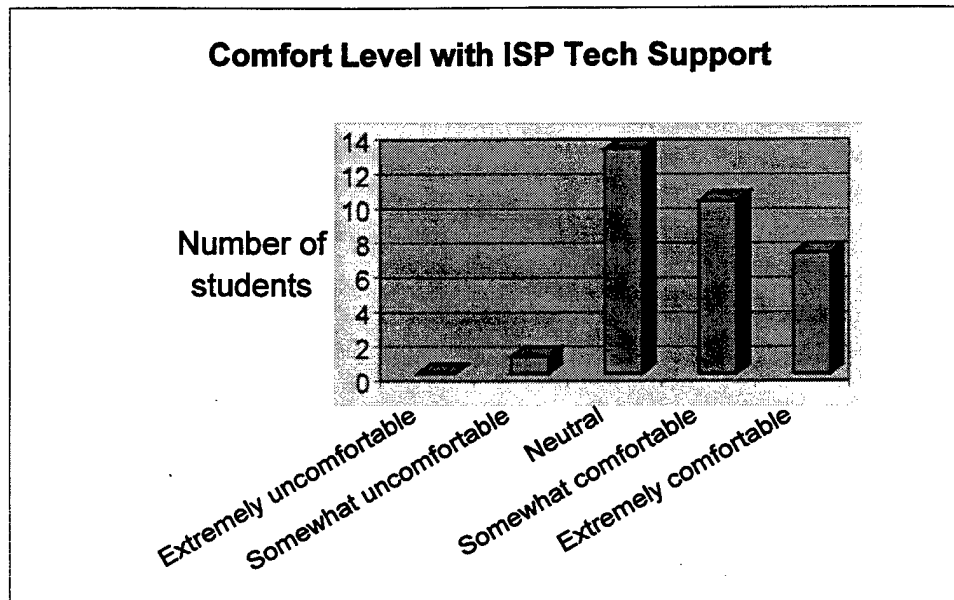


Figure 16. Distribution of Responses on Comfort Level with the Technical Support Provided by the ISP.

N = 31	Mean = 3.74	Median = 4
Minimum = 2	Maximum = 5	Mode = 3

This distribution was very similar to the responses to the WebCT technical support question, with a slight difference. There were more neutral answers (fourteen or 45.16% did not need any help from their ISP) and only one uncomfortable student. This variable had significant correlation with three other variables (Table 18).

Question	ρ	p value
'How would you rate your comfort level at this point with posting to the forum?'	0.489	0.005
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.399	0.026
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.395	0.028

Table 18. Significant Correlations and Levels of Significance between the Comfort Level with the Technical Support Provided by the ISP and Other Variables (Ordered by Level of Significance).

Found correlations are statistically significant, but mild. Students comfortable with ISP support tended to feel more comfortable with posting e-mail and with the course features of the syllabus and course overview.

The following question was about student comfort level with automated data processing (ADP) office technical support. The responses were distributed as follows in Figure 17. Eighteen responses (58.06%) were neutral. It seems students did not have to rely very much on these support tools. Only two students (6.45%) students said they were 'somewhat uncomfortable'.

Only one variable was statistically significantly correlated with this variable. It was the comfort level with the course overview feature ('How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'). Spearman's coefficient of rank correlation was $\rho = 0.405$, and the significance level $p = 0.024$.

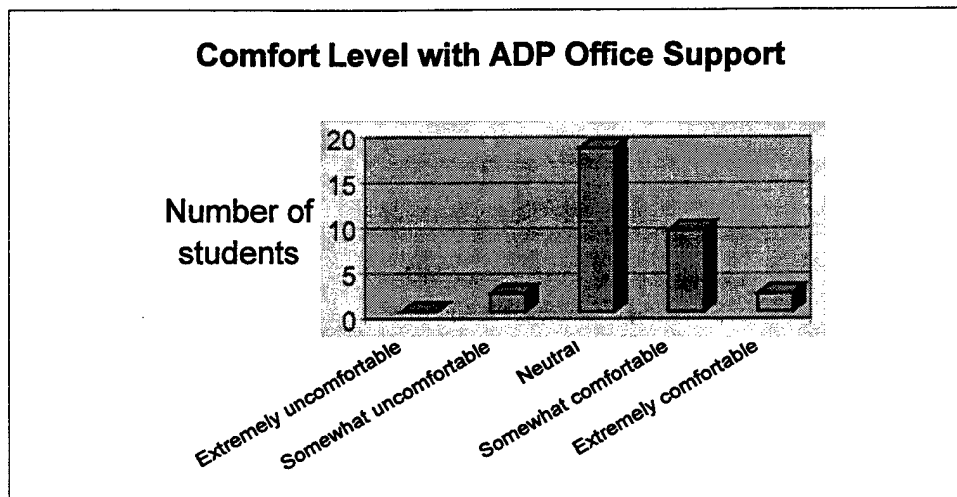


Figure 17. Distribution of Responses on the Comfort Level with the Technical Support Provided by the ADP Office,

N = 31	Mean = 3.35	Median = 3
Minimum = 2	Maximum = 5	Mode = 3

The instructor was also interested in the student comfort level with the 'Pegasus' CD-ROM provided by CFU. The question was: 'How would you rate your comfort level at this point with the technical support available to you on CD-ROM?' Figure 18 shows how the student responses were distributed.

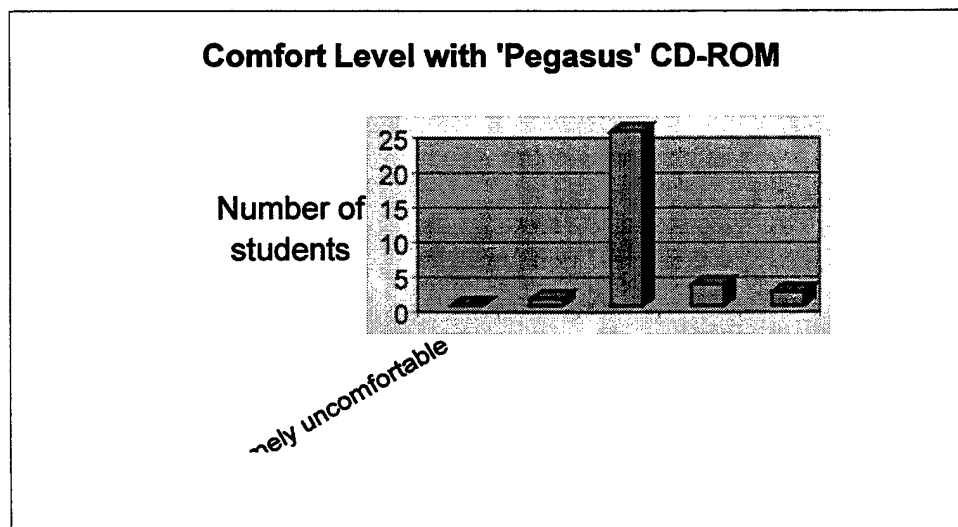


Figure 18. Distribution of Responses on the Comfort Level with the Technical Support Provided with the CD-ROM.

N = 31	Mean = 3.19	Median = 3
Minimum = 2	Maximum = 5	Mode = 3

Most students (25 students or 80.65%) responded neutrally to this question. Only six responses were non-neutral, and one of these six was negative ('somewhat uncomfortable'). However, four correlations between this and other variables were statistically significant (Table 19).

Question	ρ	p value
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.472	0.007
'How would you rate your comfort level at this point with posting to the forum?'	0.410	0.022
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.392	0.029
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.362	0.045

Table 19. Significant Correlations and Levels of Significance between the Comfort Level with the CD-ROM and Other Variables (Ordered by Level of Significance).

The first correlation tells us that same students who had a lower comfort level with the CD-ROM tended to have a lower comfort level with forums in general, with posting to forums, and with the links feature. Also, they tended to see rules of engagement less effectively than other students.

Next was the open-ended question about other technical problems. Its text was: 'What technical issues (e.g., those related to WebCT, Internet Services, Local ADP, CD-ROM, etc.) do you still need to resolve?' Nineteen students responded 'None'. I grouped the rest of responses into three main groups:

Quiz

- The grading problem with the quizzes
- The only issue is problem with the quizzes. However, I know that's being worked
- It's frustrating that the quiz portion is still not functioning properly - I do not want to get too far ahead into the course and then have to back up and remediate several quizzes at one time once it get fixed

I Haven't Started Yet⁶

- Don't know yet!
- Haven't had to use any
- All answers should be 'n/a' because I have yet to use them

Miscellaneous

- The inability to use certain links from the course schedule, and the problems with scoring quizzes
- Some of the questions do not pertain in Q11. 'N/a' should be given as a response option⁷
- Just glitches everyone else is having (with WebCT)
- None other links than those that are group problems. (Not being able to take the quizzes and the schedule links.)
- Problems logging on from AOL
- What CD?⁸

After this, there was another open-ended question about any other possible thoughts on this aspect of the course ('Please provide any additional thoughts.'). Twenty-seven students did not have any comments and four students did. Here are the comments:

⁶ This means that these students didn't have opportunity to face any technical problems yet.

⁷ Comment about this questionnaire.

⁸ This student didn't have any information about 'Pegasus' CD-ROM.

Negative Comment

- In general, tech support sucks. Most of these people can't think beyond the canned answers for them within a computer thus making the support they can provide you minimal and, ultimately, useless. Which is not to say that good tech support is not available. Just that it's not available for the categories you listed and the companies that provide them (Pacific Bell, NPS).

Neutral Comments

- The WebCT interface still needs some work
- The problems that I usually encounter are the same that other are encountering

Positive Comment

- Help has been great!

The next eight five-point scale questions asked the students how comfortable they were with different features used in the course: forums, e-mail, rules of engagement, etc.

The first question was about the forum feature: 'How would you rate your comfort level at this point with the forum feature being used to teach this course?' Figure 19 shows the distribution.

An overwhelming majority of the students was feeling 'somewhat comfortable' (17 students or 54.84%) or 'extremely comfortable' (seven students or 22.58%) with the forums. Only four (12.90%) felt uncomfortable (one of them 'extremely uncomfortable'), and three other students were neutral. Interestingly, their responses to this question are similar but not identical to the question about the comfort level with posting to forums (Figure 13). Briefly, more of them were 'extremely comfortable' with posting to the forums than with the use of the forums in the course.

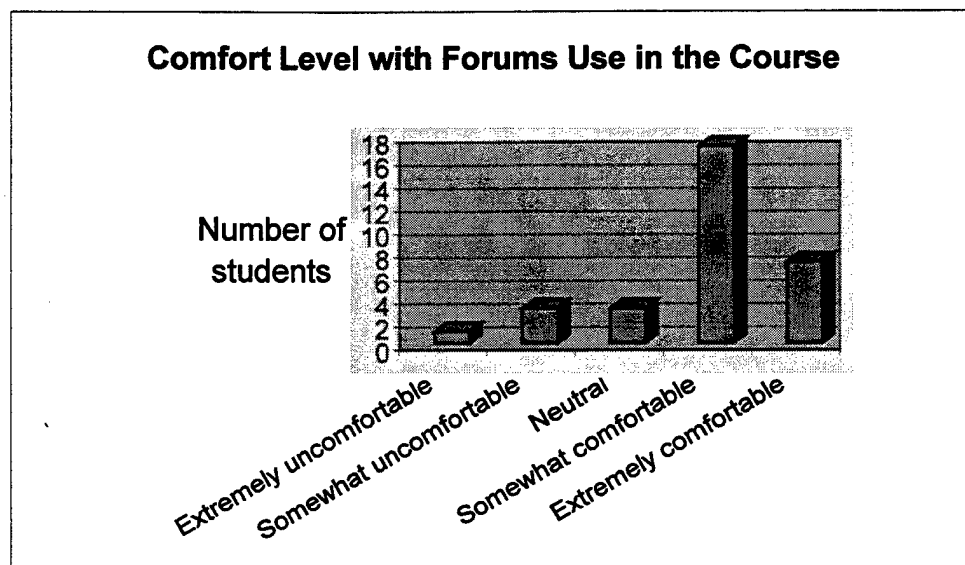


Figure 19. Distribution of Responses on the Forums Used in the Course.

N = 31	Mean = 3.84	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

The calculation showed that ten rank correlations between this and other variables were statistically significant (Table 20).

The highest correlation is between two variables asking about the comfort level with posting to the forums and about the comfort level with the use of forums in the course. Setting-up the systems, accessing the Internet, using word-processing, and comfort with sending e-mail appeared to be important issues correlated with the comfort of use of the forums and with a few other variables in this set.

Question	ρ	p value
'How would you rate your comfort level at this point with posting to the forum?'	0.800	< 0.001
'How would you rate your comfort level at this point with setting-up your system?'	0.614	< 0.001
'How would you rate your comfort level at this point with accessing the Internet?'	0.587	0.001
'How would you rate your comfort level at this point with word processing?'	0.503	0.004
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.491	0.005
'How would you rate your comfort level at this point with the technical support available to you on CD-ROM?'	0.472	0.007
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.406	0.023
'How would you rate your comfort level at this point with sending electronic mail?'	0.392	0.029
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.360	0.047

Table 20. Significant Correlations and Levels of Significance between the Comfort Level with Use of the Forums in the Course and Other Variables (Ordered by Level of Significance).

Next was the question about the comfort level with the use of e-mail features in the course (Figure 20).

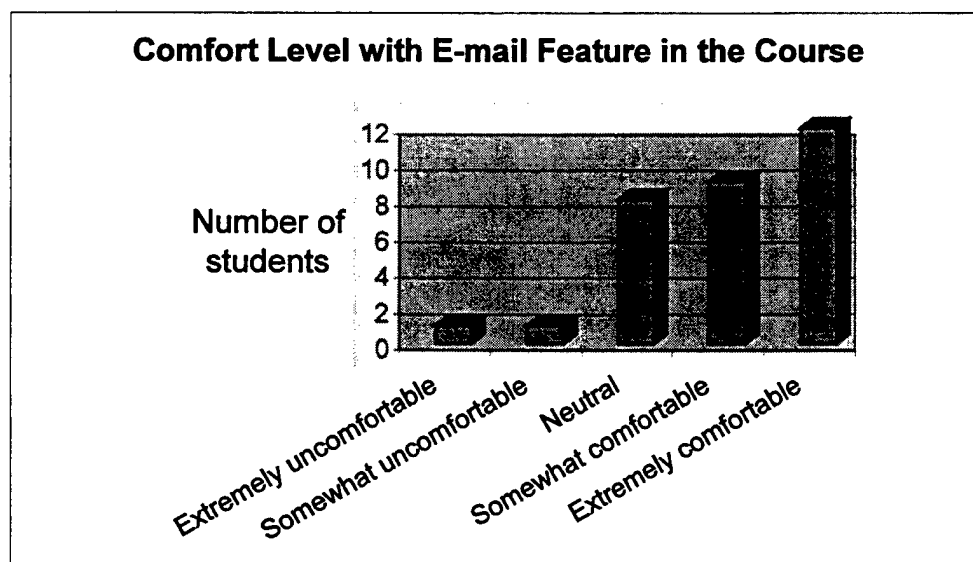


Figure 20. Distribution of Responses on the Comfort Level with the E-mail Feature in the Course.

N = 31	Mean = 3.98	Median = 4
Minimum = 1	Maximum = 5	Mode = 5

There is a very obvious difference between this distribution of responses and the responses to the question about the comfort level with sending e-mail (Figure 14), where over 26 students (83.87%) responded to being 'extremely comfortable'. Here only thirteen students (41.94%) chose the same response. It is not clear why so many students (nine or 29.03%) chose a neutral answer. It could be because of the frequency, content, or other characteristics of e-mail messages they were receiving from the instructor, or they did not quite understand the question. Table 21 shows the correlations between this and other variables. Correlations are moderate.

Question	ρ	p value
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.491	0.005
'How effective were module objectives? That is, to what extent did the module objectives help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.491	0.005
'How would you rate your comfort level at this point with accessing the Internet?'	0.477	0.007
'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.436	0.014
'How would you rate your comfort level at this point with word processing?'	0.425	0.017
'How would you rate your comfort level at this point with sending electronic mail?'	0.410	0.022
'How would you rate your comfort level at this point with the technical support provided for using the WebCT software?'	0.406	0.023

Table 21. Significant Correlations and Levels of Significance between the Comfort Level with the E-mail Feature in the Course and Other Variables (Ordered by Level of Significance).

As in many other similar cases, several different variables with the comfort level answers about various aspects of the course (forums, accessing the Internet, word processing) and course features (course overview, module objectives) are correlated with medium to lower-medium coefficients⁹.

The following question asked students about the quiz feature: 'How would you rate your comfort level at this point with the quiz feature being used to teach this course?' Figure 21 shows the distribution of the responses.

Interestingly, in the distribution of the student responses students split into two different groups: approximately one third of the students (ten students or 32.26%) said they felt uncomfortable with the quiz feature (half of them 'somewhat', another half 'extremely uncomfortable'), and two thirds (nineteen students or 61.29%) comfortable. Only two students chose a neutral response. The fact that during the course there were some technical problems with the quizzes only partially explains such a distribution. Also, the instructor's notes suggest that the students had different interpretations of the importance of the quizzes in determining their final grade. This phenomenon will be examined in the section on interviews with students.

This variable has statistically significant rank correlations with six other variables in the instrument (Table 22).

⁹ Statisticians usually consider correlations over 0.75 or 0.80 as 'high' and those below 0.50 or 0.45 as 'low'. They do not take into consideration at all any correlation if it is not statistically significant with at least a previously determined level of significance.

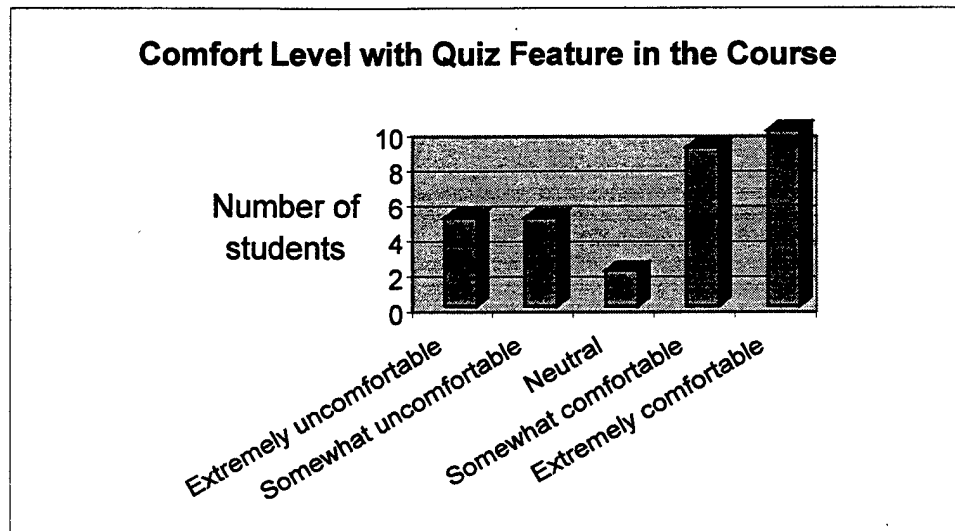


Figure 21. Distribution of Responses on the Comfort Level with the Quiz Feature in the Course.

N = 31 Mean = 3.45 Median = 4
 Minimum = 1 Maximum = 5 Mode = 5

Question	ρ	p value
'How would you rate your comfort level at this point with posting to the forum?'	0.537	0.002
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.531	0.002
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.401	0.026
'How would you rate your comfort level at this point with accessing the Internet?'	0.399	0.026
'How would you rate your comfort level at this point with word processing?'	0.388	0.031
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.360	0.047

Table 22. Significant Correlations and Levels of Significance between the Comfort Level with the Quiz Feature in the Course and Other Variables (Ordered by Level of Significance).

The next question was: ‘How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?’ The distribution of the responses is shown in Figure 22.

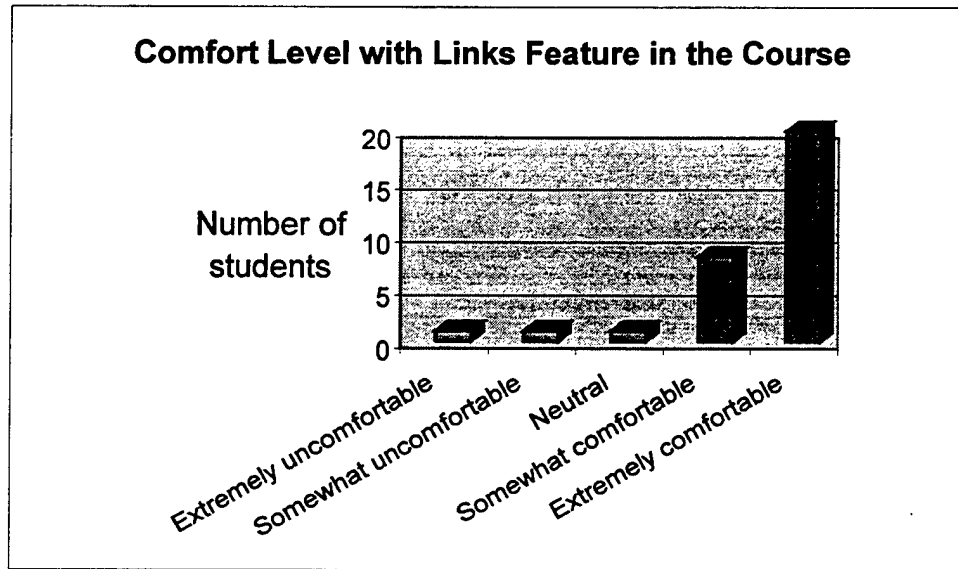


Figure 22. Distribution of Responses on the Comfort Level with the Links Feature in the Course.

N = 31	Mean = 4.45	Median = 5
Minimum = 1	Maximum = 5	Mode = 5

The vast majority of the students (twenty-one students or 67.74%) were ‘extremely comfortable’ with links as an important component of the on-line course material. Less (seven or 22.58%) were ‘somewhat comfortable’, and only two of them indicated they felt uncomfortable. Of all the course features we analyzed so far in this chapter, links clearly had the highest comfort level among the students.

Table 23 lists eleven variables that have statistically significant rank correlations with the links-related comfort level. The comfort level with the links feature highly correlates with the comfort level in accessing the Internet, and the correlations are

somewhat lower with the comfort level with word processing, sending e-mail, and other on-line course features like rules of engagement and module objectives.

Another element of on-line course materials was the course overview. The question was: 'How effective was the course overview? That is, to what extent did the course overview help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?' Figure 23 shows the distribution of the responses.

Question	ρ	p value
'How would you rate your comfort level at this point with accessing the Internet?'	0.728	< 0.001
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the Space Systems Technologies and Applications on-line course?'	0.629	< 0.001
'How would you rate your comfort level at this point with word processing?'	0.541	0.002
'How would you rate your comfort level at this point with sending electronic mail?'	0.540	0.002
'How effective were module objectives? That is, to what extent did the module objectives help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.524	0.002
'How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?'	0.529	0.003
'How effective was the course overview? That is, to what extent did the course overview help you (...)?'	0.499	0.004
'How would you rate your comfort level at this point with posting to the forum?'	0.464	0.009
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.406	0.023
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.401	0.026
'How would you rate your comfort level at this point with the technical support available to you on CD-ROM?'	0.362	0.045

Table 23. Significant Correlations and Levels of Significance between the Comfort Level with the Link Feature in the Course and Other Variables (Ordered by Level of Significance).

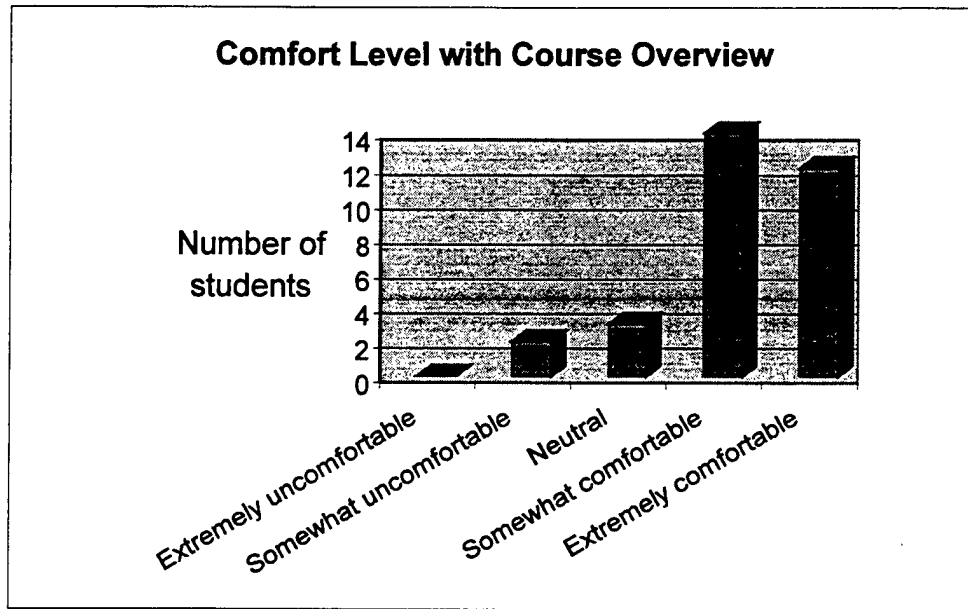


Figure 23. Distribution of Responses on the Comfort Level with the Course Overview.

N = 31	Mean = 4.16	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

Only three students (9.67%) felt 'somewhat uncomfortable' with the course overview, and three students (9.67%) chose neutral statements. Most of the students (14 or 45.16%) felt 'somewhat comfortable', and the remaining students (12 or 38.71%) even 'extremely comfortable', which gives very encouraging feedback to the course instructor. The correlations between this and other variables are shown in Table 24.

These correlations clearly show a significant level of association between all additional on-line course content created by the instructor to facilitate student learning: course overview, rules of engagement, module objectives, and course syllabus. In other words, the same students who felt uncomfortable with any of these textual features used in the course, tended to have a similar impression about some of the other content areas in the course. Other variables, those reflecting 'core on-line issues', such as the comfort

level with accessing the Internet or with word processing, and some others such as the comfort level with ADP office support, were significant.

Question	ρ	p value
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you (...)?'	0.621	< 0.001
'How would you rate your comfort level at this point with accessing the Internet?'	0.581	0.001
'How effective was the course syllabus? That is, to what extent did the course syllabus help you (...)?'	0.569	0.001
'How effective were module objectives? That is, to what extent did the module objectives help you (...)?'	0.515	0.003
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.499	0.004
'How would you rate your comfort level at this point with posting to the forum?'	0.445	0.012
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.436	0.014
'How would you rate your comfort level at this point with word processing?'	0.424	0.017
'How would you rate your comfort level at this point with setting-up your system?'	0.421	0.018
'How would you rate your comfort level at this point with sending electronic mail?'	0.415	0.020
'How would you rate your comfort level at this point with the technical support available to you through the school ADP office?'	0.405	0.024
'How would you rate your comfort level at this point with the technical support available to you through your Internet service provider (ISP)?'	0.395	0.028

Table 24. Significant Correlations and Levels of Significance between the Comfort Level with the Course Overview and Other Variables (Ordered by Level of Significance).

The next item was: 'How effective were module objectives? That is, to what extent did the module objectives help you to understand what you would learn in the Space Systems Technologies and Applications on-line course?' The distribution of the student responses is shown in Figure 24.

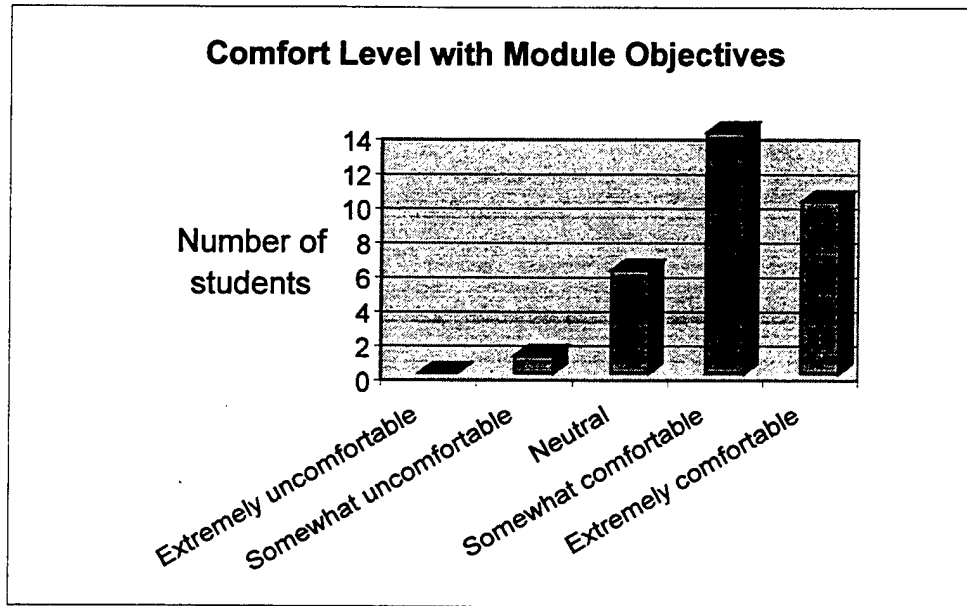


Figure 24. Distribution of Responses on the Comfort Level with the Module Objectives.

N = 31	Mean = 4.06	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

This distribution is very similar to the distribution of the responses on the comfort level with the course overview (Figure 23), except there were somewhat more neutral responses. Only one student felt somewhat uncomfortable with module objectives.

Eight correlations were significant. Similar comments apply to this question about comfort level with module objectives as with the previous one: correlations between additional on-line course contents ('course overview' and 'course syllabus) and 'core on-line issues' dominate (Table 25). A similar tendency can be expected with responses to the next two questions also.

Question	ρ	P value
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you (...)?'	0.565	0.001
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.524	0.002
'How effective was the course syllabus? That is, to what extent did the course syllabus help you (...)?'	0.523	0.003
'How effective was the course overview? That is, to what extent did the course overview help you (...)?'	0.515	0.003
'How would you rate your comfort level at this point with the email feature being used to teach this course?'	0.491	0.005
'How would you rate your comfort level at this point with the forum feature being used to teach this course?'	0.473	0.007
'How would you rate your comfort level at this point with the technical support provided for using the WebCT software?'	0.462	0.009
'How would you rate your comfort level at this point with accessing the Internet?'	0.406	0.023

Table 25. Significant Correlations and Levels of Significance between the Comfort Level with the Module Objectives and Other Variables (Ordered by Level of Significance).

The next question was: "How effective were the rules of engagement? That is, to what extent did the rules of engagement help you to understand what would be involved in taking the 'Space Systems – Technologies and Applications' on-line course?" The distribution of the student responses is in Figure 25.

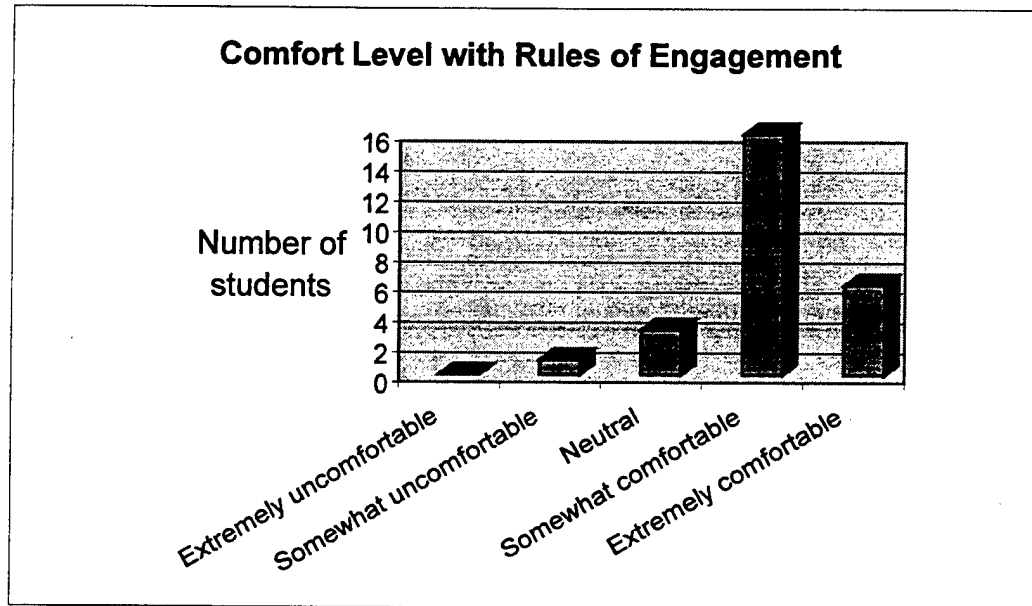


Figure 25. Distribution of Responses on the Comfort Level with the Rules of Engagement.

N = 31	Mean = 4.19	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

This distribution follows a similar pattern as the previous two. There were more 'somewhat comfortable' responses: 51.61% to this question compared to the previous two questions (45.16%). Only one student expressed feeling uncomfortable with the rules of engagement in the course.

Table 26 shows all significant correlations between this and the other variables.

Question	ρ	p value
'How effective was the course syllabus? That is, to what extent did the course syllabus help you (...)?'	0.718	< 0.001
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.629	< 0.001
'How effective was the course overview? That is, to what extent did the course overview help you (...)?'	0.621	< 0.001
'How effective were module objectives? That is, to what extent did the module objectives help you (...)?'	0.565	0.001
'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.531	0.002
'How would you rate your comfort level at this point with posting to the forum?'	0.456	0.010
'How would you rate your comfort level at this point with accessing the Internet?'	0.451	0.011
'How would you rate your comfort level at this point with word processing?'	0.450	0.011
'How would you rate your comfort level at this point with setting-up your system?'	0.441	0.013
'How would you rate your comfort level at this point with sending electronic mail?'	0.439	0.013
'How would you rate your comfort level at this point with the technical support provided for using the WebCT software?'	0.408	0.023
'How would you rate your comfort level at this point with the technical support available to you on CD-ROM?'	0.392	0.029

Table 26. Significant Correlations and Levels of Significance between the Comfort Level with the Rules of Engagement and Other Variables (Ordered by Level of Significance).

Correlations followed a very similar pattern as discussed above.

The last five-point scale question in this instrument was: "How effective was the course syllabus? That is, to what extent did the course syllabus help you to understand what you would learn in the 'Space Systems Technologies and Applications' on-line course?" Figure 26 shows the distribution of the responses.

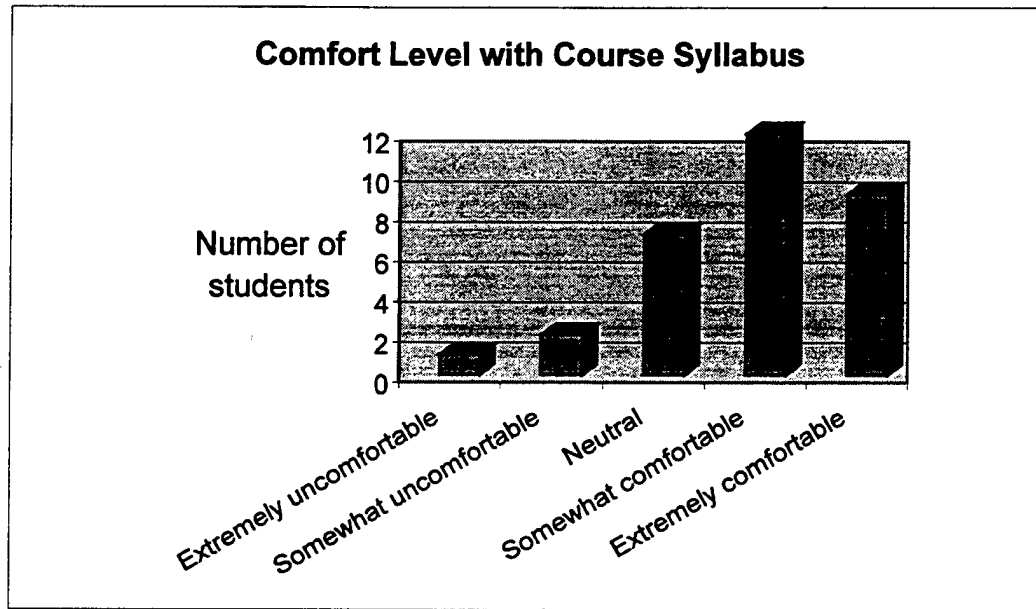


Figure 26. Distribution of Responses on the Comfort Level with the Course Syllabus.

N = 31	Mean = 3.84	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

Three students (9.68%) felt ‘uncomfortable’ about the course syllabus, and seven (22.58%) chose a neutral response. The latter students probably did not carefully examine the syllabus. Twenty-two (70.97%) felt ‘comfortable’ (almost equally divided between ‘somewhat’ and ‘extremely comfortable’. Correlations formed a similar pattern for the comfort level with the course overview, module objectives, and rules of engagement. Table 27 shows coefficients and significance levels.

These correlations also followed the expected pattern.

At the end of the questionnaire, there were five open-ended questions asking the students about needed help with the web-based features, general liking of the course, concerns, suggestions, and question on how they would create their own on-line course if they were instructors.

Question	ρ	p value
'How effective were the rules of engagement? That is, to what extent did the rules of engagement help you (...)?'	0.718	< 0.001
'How effective was the course overview? That is, to what extent did the course overview help you (...)?'	0.569	0.001
'How effective were module objectives? That is, to what extent did the module objectives help you (...)?'	0.523	0.003
'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.509	0.003
'How would you rate your comfort level at this point with sending electronic mail?'	0.434	0.015
'How would you rate your comfort level at this point with posting to the forum?'	0.422	0.018
'How would you rate your comfort level at this point with setting-up your system?'	0.401	0.026
'How would you rate your comfort level at this point with the technical support available to you through your Internet service provider (ISP)?'	0.399	0.026
'How would you rate your comfort level at this point with accessing the Internet?'	0.398	0.027

Table 27. Significant Correlations and Levels of Significance between the Comfort Level with the Course Syllabus and Other Variables (Ordered by Level of Significance).

The first of these open-ended questions was the question about help the students might need: 'In what areas do you still need help with the web-based technological features (forum, email, quizzes, links, etc) used to teach this on-line course?' Twenty students answered they needed no such help. Here are the other answers, systematized:

Quiz

- None - just fix the quiz section
- Fix quiz 2, get quiz 3 up and running
- I await resolution of the quiz technical difficulties
- The quizzes obviously need to be repaired technically
- Quizzes - we just want the site fixed
- Quizzes need a summary which questions are wrong and unanswered

Other and unclear

- Forum posting
- There are still some minor bugs

Neutral

- I haven't used e-mail. Quiz grading is much better

The responses clearly suggest that at the moment of responding to this on-line questionnaire, the only significant technical problem that the students needed help with was the 'bug' in quiz scoring (six of the ten responses addressed this issue).

The second question asked students if they liked the course: 'So far, what do you like about this on-line course?' Here is how the students responded:

Time management flexibility and accessibility¹⁰

- Accessibility
- Can work on it at my leisure
- Convenience to do it on my schedule
- Ease of access... Able to access around my schedule
- Flexibility of my schedule - ability to review - additional web links to areas of interest
- Flexibility! [Three answers]
- Freedom to work at own pace
- I can do it anytime
- I like the pace. However, I'm not sure if I'm learning more or less than what is expected.
- Self paced with visible objectives and requirements
- Self-paced. You can work it into your schedule easier

¹⁰ These two types of answers were combined together because, according to student responses, they seem to be very close to each other within the context of the on-line course.

- The ability to manage your own time
- The convenience of managing my time as it relates to the requirements of the class. I can spend extra time or less time as required.
- The convenience of the course, i.e. being able to do the course whenever I choose
- The flexibility to learn when I am ready to
- The freedom of time...
- The autonomy. I like doing the work on my own so I can skim what I already know and go deeper on things that interest me.

Forums

- The forum interaction is great, but I would agree with the posting that we should meet once a week or so at the later stages of the course to have question/answer periods with the instructor

Multiple answers and miscellaneous

- I can work on it all hours and at my home PC. Also the continuous postings to the forums are beneficial.
- I like the forums format. I also like the links in the modules
- I like the layout and interface real well. Although the text is extremely extensive, it has been informative and enjoyable to read so far.
- I like the links and forum feature
- I like the links to sites that I may not have found otherwise. The book seemed a tad bit too simple at first, but as I got to the orbit section, there is some in-depth material.
- Multiple-choice open book repeatable quizzes
- Still working
- The ability to crawl out of the rack and check the forums, and make comments. The ability to do the work to better fit my schedule.
- The text and the links
- Very insightful discussions in the forum; excellent support for technical issues; a very responsive instructor; and links to very interesting web sites

Clearly, the students outlined time flexibility and accessibility of the course material whenever it suits them as main reason for liking the course (19 out of 30

responses or 63.33% of the responses) The same issues are also mentioned in three of the answers in the third group (Multiple Answers and Miscellaneous).

The next question asked students about concerns they had about the course: 'So far, what are your concerns about this on-line course?' Eleven students responded 'None' or did not respond at all which implies they had no significant concerns. Other responses are systematized as follows:

Forum

- Too many forum postings! It's just too difficult and time consuming to realistically read everything that everyone posts. Forum groups need to be broken down (say, 5-7 people) so that we can share ideas in a smaller group. Also, the fact that we are getting behind with Modules that don't work is frustrating. It's as if we're at a standstill and will need to catch up later on.

Comparison with face-to-face class

- Depth of knowledge vs. in-class instruction
- I am concerned that I may not be getting the same information as my counterparts in the in-room class
- See above #25. I've learned some things... Not sure if I'm getting the same value as students who are actually sitting in a classroom with a professor.

Learning pace and organization

- Getting too far ahead in the assignments without being able to keep up with the quizzes because that section is not working properly
- Keeping up on the readings and not falling behind
- My personal lack of urgency for the first couple of weeks. And my unwillingness to read something posted over a paragraph or two in length.

Technical problems

- Run-time errors... They are not due to my memory allocation because I'm getting them no matter what computer I'm accessing the web site from...

- The apparent slowness with which the WebCT has been able to resolve the technical problems associated with the quizzes
- The password and user id issue, but that has been addressed
- Too many problems up front that should have been worked out ahead of time

Grading

- How will we be graded?
- I'm concerned with how we will be evaluated given that we're having problems with scoring the quizzes.
- That some wordy students will get better grades, even when the context is not worthy. I hope that the grade is based on the quality of the content, not the quantity. A lot of the comments are verbose and boring.

Multiple answers and miscellaneous

- My only concern so far is about missing an event. Since some of the items are not working, I may overlook a part this is working.
- The lack of interaction with the professor
- Too cumbersome to always check for replies... Also sometimes ready to take quiz or evaluation and it has not been posted yet.

Positive opinions

- No negative concerns, I am very positive and motivated to continue into deep space!
- That there will be no more after this. It is a great medium for learning
-

There was no one predominant issue students addressed, but students expressed concerns about different themes. Some responses seem to be unrelated to the specific DL nature of the course, but were more general student concerns (learning pace and organization) that appear in any type of class. Student concerns are grouped around the following issues: technical problems (four comments); uncertainty whether the

possibilities of DL are equal to those is face-to-face class (three); grading (three); forums (one) and mixed/miscellaneous problems (three comments).

The next question put students into the position of thinking how they would organize a DL course: 'Please respond to the following question. If I were building an on-line course to teach space systems-related instruction, I would...' The students gave many responses to this question, and after analysis of their content I formed six different groups of responses based on similar themes in their comments. Here are the grouped responses:

Just like this course

- ...Do exactly what you are doing.
- Copy that format!
- Do exactly what you're doing. I think we're getting a good overview of Space and are taking away a lot of useful information.
- Model it pretty much like you have
- Not change a damn thing
- Try to do as good as you have... Really! It is a good program with a layout that makes navigation easy.

I'm too new to say

- Don't know
- I am just starting; ask me at the end
- I haven't really thought about it, but I am a novice at on-line courses, so my input wouldn't really contribute anything substantial at this time

Hire someone

- Find experts on distance learning through technology (which has been done here already)
- I would hire someone to do it, because it's beyond me

First, fix what you can

- Conduct thorough system testing and evaluation and keep the class small till all the bugs are worked out
- Ensure that the various pieces were working before beginning. This is not meant as sarcastically as it sounds.
- Ensure the system is up and running before starting a class with students. I would require a 'dry run' of the entire course and all features completed
- I'd get a better feel for how it is going to work before putting online. Possibly hold this 'online' class IN class, using it as a group first. Seems to be too many unknowns. Also, it would REALLY benefit us to be able to meet from time to time to assess the class and where all of us stand. I understand that the point of the class is so the distance learning can occur, but since the class is in its genesis, perhaps meeting once every two weeks would provide insight that the forum cannot.
- Keep fixing the bugs and add more user help key like spell check and summary charts for graded answers
- Work out the bugs ahead of time - I think you have done a great job with the layout and interface thus far

Content improvements

- Add CCTV/tape like instruction by instructor on key points
- Arrange online chats with industry specialists. Follow the same format as presented (but without the bugs).
- Have more mathematical or practical applications
- Provide links (outsource or internal) that would provide a hands-on approach to solving some of the questions/problems, i.e., orbital model that actually used the information that we input

Instruction methods improvements

- Continue to require the Professor to keep students on track via email. Those emails add confidence and understanding to the student as what the instructor exactly expected them to accomplish. A syllabus is nice, but as always changes occur. In an online course, little changes create confusion even worse than in regular class. Those emails from the professor help.
- Ensure that complete communication via email is always available letting me know when forums have been replied to, when quizzes and evaluation are opened

- Have to learn a lot more about both space systems and distance education
- Keep the learning process as well as the testing setup simple and straightforward
- Limit the length of the postings and smaller group forums sooner
- One thought. In the forum people write very LARGE paragraphs. It is difficult to read online and follow. Part of the rules of the road should be to write 4/5 sentences and then make a break and continue. Just like I am doing now. I would argue people would be more inclined to read 5/6 blocks of text vise one humungous block of text.
- Use a great textbook like the one we have and encourage students with regular e-mails (good job!)

The last question in this questionnaire asked students if they had suggestions: 'Do you have any suggestions, at this point (in particular, about your orientation to taking a course on-line)?' Eighteen of them did not respond or answered 'None', 'Nothing yet', or 'Nothing at this time'. Three students responded that they have answered this question previously. Here are the answers of the remaining students:

Advice and ideas

- It seems like the bases are pretty well covered. We can interact online and get questions answered quickly.
- Just some more QC¹¹ on the links and quizzes
- Limit forum size to 10 people (Forum teams A, B, C, D... Gold, Blue, Red, Green... Whatever... Poring through a plethora of responses can be somewhat tiring...
- The forum discussions were lagging during the technical chapters

Positive opinions

- A hesitant 'I'd do it again based on this course'. The caveat is that some courses (like Calculus) wouldn't lend themselves as well to online teaching (in my humble opinion).
- Make sure requirements of the students are clearly defined at all times

¹¹ Quality control.

- The orientation was good and the tech support has been very responsive

Neutral

- None at this time. I think it is a good idea to combine the quizzes when technical difficulties are encountered; it keeps things tracking along to the next module.
-

Second questionnaire - Summary

Statements on comfort levels showed that positive responses dominate, but the distributions of the student responses are not the same in all cases. For instance, the highest level of comfort the students had was with accessing the Internet. Issues like setting up one's own system, posting to forums, or WebCT technical support had some negative responses also. Some statements clearly had the highest level of comfort, but some students gave negative responses anyway as in the statements about using word processing or sending e-mail.

A few statements produced an exceptionally large number of neutral responses such as the statement on ISP technical support or on ADP office support. This occurred because most students did not use those services.

The open-ended question about needed technical help clearly indicated that posting to forums was a central problem.

Eight statements asked the students about the comfort level with the use of different features in the course: forums, e-mail, quiz, links, course overview, module objectives, rules of engagement, and course syllabus. Distributions differ among these variables, although students mostly chose positive responses. Sending e-mail had the

most responses of 'extremely comfortable', but there were some students who felt uncomfortable even with that.

Asked about additional help with web-based features, six students emphasized problems with the quiz, but there were other responses also.

Another open-ended question asked the students what they liked about the on-line course. Nineteen comments could be classified as 'time management flexibility and accessibility'. Other features were mentioned also: forums (six times, alone or in combinations), links (four responses), quizzes, and support.

I divided the responses to questions about student concerns into the following groups: technical problems (four responses); uncertainty about comparability of DL to face-to-face classes (three); learning pace and organization (three); grading (three); combinations and other (four). Only two students gave very positive responses to this question.

Near the end of the questionnaire, students were asked to respond to the following statement: 'If I were building an on-line course to teach space systems-related instruction, I would...' Their responses were grouped around: 'Instructional methods improvements' (seven responses); 'I would do just same as in this course (six responses); 'First, fix all what you can' (six); 'I'm too new to say' (three); and 'Hire someone' (two responses'.

3. Module 14 Questionnaire

This questionnaire (Appendix C) was administered immediately after module 14 was completed, i.e., close to the end of the course (the course had 15 modules). Since module 14 was different from the others (special guest and a subject matter expert was available for interactions with the students), the instructor wanted to learn how much the

students benefited from the module 14 learning objectives. The instructor formulated these statements.

I added several questions about the current comfort level with important features used in the course so that the changes in comfort levels from the beginning of the course to date could be examined.

Since the students for this on-line questionnaire were identifiable by name, it was possible to compare their responses to this questionnaire with data from other instruments: the first questionnaire, student tracking data, and even final course grades.

First the students were asked to respond on seven-point scales to seven statements about achieving learning objectives in Module 14. The next six statements provided were about the student comfort level with features used in the course. At the end of this questionnaire, the students were given an opportunity to add their own comments.

Twenty-six students completed this questionnaire.

The first question was: 'Throughout Module 14 you developed and practiced your skills in the process of analyzing, articulating, and evaluating DoD Space Control issues. The statements below reflect the learning objectives for Module 14. To what extent do you agree that the material presented in the Module enabled you to achieve the learning objectives? Identifying key elements of Space Control.' Figure 27 shows the distribution of the responses.

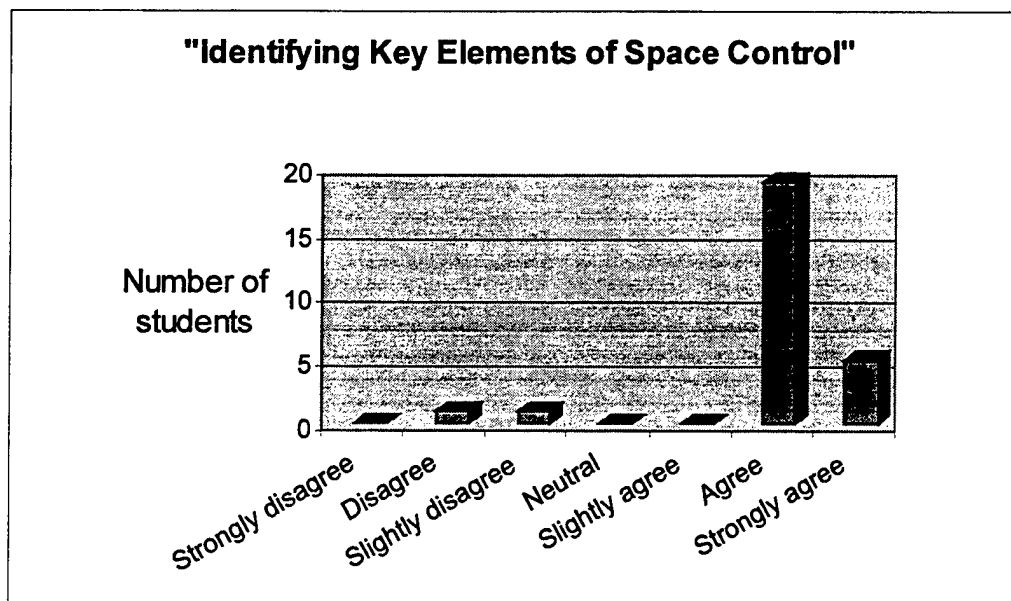


Figure 27. Distribution of the Responses to the First Statement.

N = 26 Mean = 5.92 Median = 6
 Minimum = 2 Maximum = 7 Mode = 6

Nineteen students (73.08%) responded with 'agree', so this learning objective was very successfully met with the module. This variable has significant correlations with fourteen variables from this and other instruments (Table 28).

Instrument	Statement / Variable	ρ	p value
Module 14	4 - 'Participating in forums (e.g. discussing, identifying/consulting subject matter experts), to evaluate space control issues.'	0.559	0.003
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	0.494	0.010
Module 14	8 - 'How would you rate your comfort level at this point with accessing the Internet?'	0.470	0.015
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.440	0.024
Fist questionnaire	'I expect this online course will be valuable and improve my learning'	0.405	0.026
Student tracking	Number of follow-up posts	0.367	0.046

Table 28. Significant Correlations and Levels of Significance between the First Statement and other Variables (Ordered by Level of Significance).

Correlations in Table 28 show that the students with a higher comfort level in sending e-mail, accessing the Internet, and the quiz feature, said that the course material helped them in higher achievement in the first learning objective. Also, they tended to have somewhat higher expectations to improve their learning throughout the course and to send more follow-up posts in forums.

The second question was: 'Synthesizing other's findings in Forums' (see explanation with first question). Figure 28 shows the distribution of the responses.

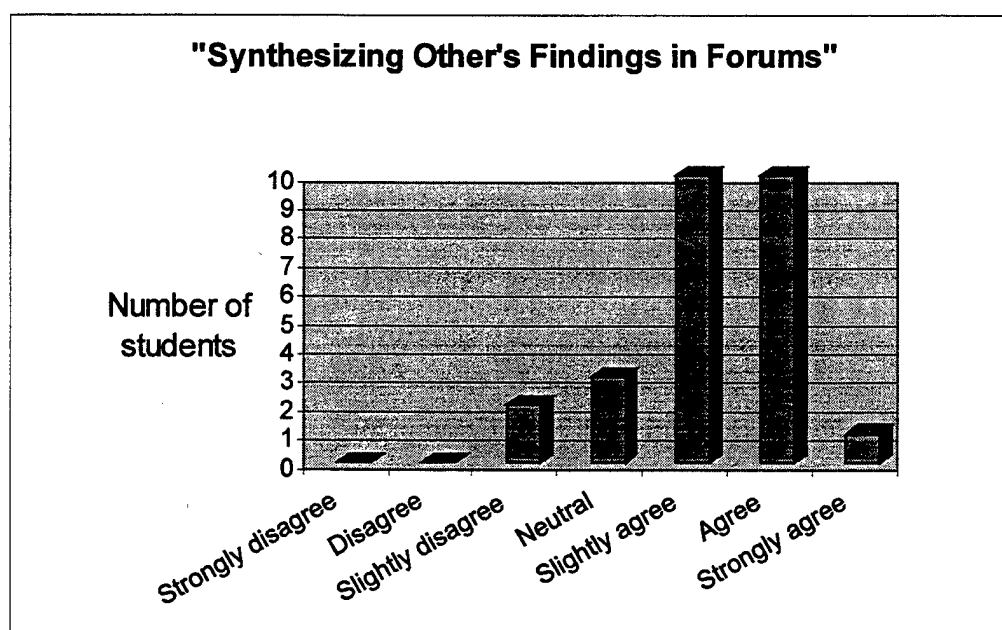


Figure 28. Distribution of the Responses to the Second Statement.

N = 26	Mean = 5.19	Median = 5
Minimum = 5	Maximum = 7	Mode = 5

Predominant responses to the second statement were 'slightly agree' and 'agree' (ten students or 38.46% chose each). Responses did not have any significant correlations with other variables, which would suggest that this learning objective is specific, without any apparent relation to any other of the variables measured with this set of instruments.

The third statement in the questionnaire was: 'Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems.' Figure 24 shows the distribution of the student responses.

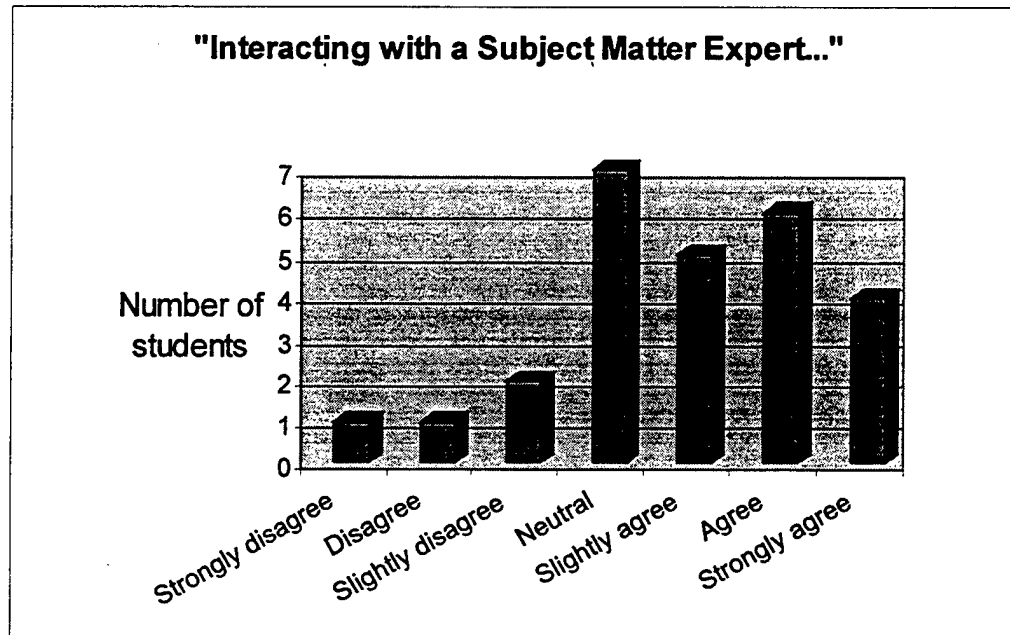


Figure 29. Distribution of the Responses to the Third Statement.

N = 26	Mean = 4.85	Median = 5
Minimum = 1	Maximum = 7	Mode = 4

Here the student responses vary more than the responses to the first two statements. Seven students (26.93%) chose neutral answers, which might be an indicator that they personally have not taken the opportunity to enter into interactions with guest – subject matter expert, or they saw this module in terms of the stated learning objectives exactly 'between successful and unsuccessful'. This variable had significant correlations with four other variables (Table 29).

Students with higher expectations in improving their learning in this course saw this interaction as more useful for their learning. Also, they tended to value participation

in forums more, and they also tended to participate more in forums by posting messages and follow-up posts to forums.

Instrument	Statement / Variable	ρ	p value
Fist questionnaire	'I expect this online course will be valuable and improve my learning'	0.450	0.012
Module 14	4 - 'Participating in forums (e.g. discussing, identifying/consulting subject matter experts), to evaluate space control issues.'	0.439	0.025
Student tracking	Number of posted messages	0.404	0.027
Student tracking	Number of follow-up posts	0.414	0.023

Table 29. Significant Correlations and Levels of Significance between the Third Statement and other Variables (Ordered by Level of Significance).

The fourth statement was the following: 'Participating in forums (e.g. discussing, identifying/consulting subject matter experts), to evaluate space control issues.' Figure 30 shows how the student responses were distributed. Eighteen students agreed (69.23%) – six 'somewhat agreed' (23.08%), nine 'agreed' (34.61%), and three 'extremely agreed' (11.54%), but there were five neutral (19.23%) and three responses (11.54%) that disagreed with the statement.

Table 30 shows four significant correlations this variable had with other variables. Insight into the variables in the table reconfirms the relationship between valuing interactivity, valuing student participation (in forums), and higher expectations in learning throughout the course. A negative sign of correlation between the responses to the fourth statement and the question from the first questionnaire about concerns of one's own abilities means that the students less concerned about their own abilities to use web-based materials in the on-line class tend to see material in module 14 as helping them more in participating in forums and evaluating space control issues.

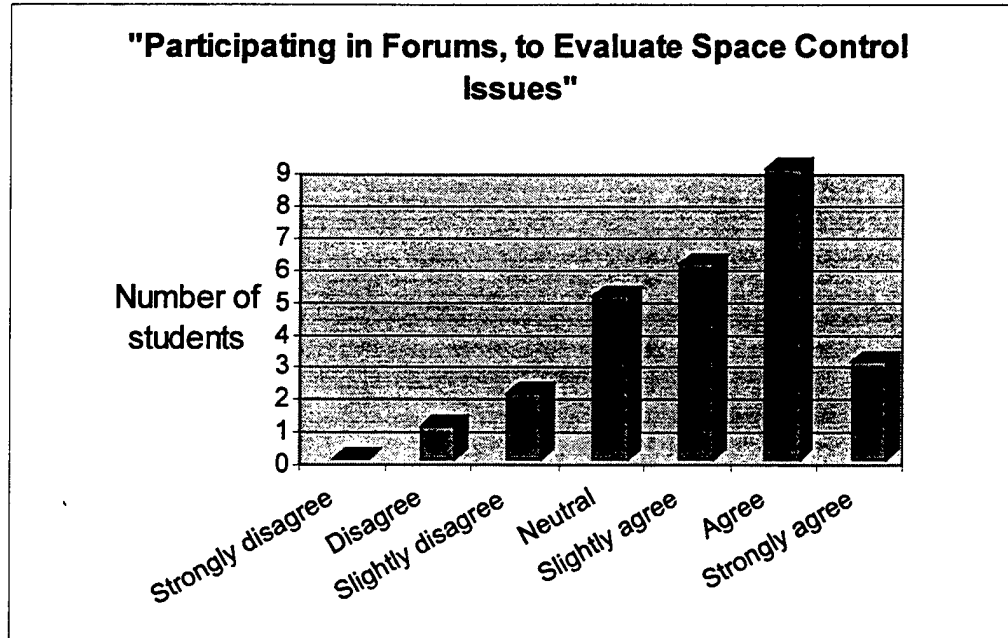


Figure 30. Distribution of the Responses to the Fourth Statement.

N = 26

Mean = 5.12

Median = 5

Minimum = 2

Maximum = 7

Mode = 6

Instrument	Statement / Variable	ρ	p value
Module 14	1 – 'Identifying key elements of Space Control.'	0.559	0.003
Module 14	3 – 'Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems.'	0.439	0.025
Fist questionnaire	'I expect this online course will be valuable and improve my learning'	0.392	0.032
First questionnaire	'I am concerned about my ability to use the web-based materials in this class'	-0.364	0.048

Table 30. Significant Correlations and Levels of Significance between the Fourth Statement and other Variables (Ordered by Level of Significance).

All the students agreed with the fifth statement, except two who gave neutral responses. Materials in module 14 successfully helped them in learning this learning objective (Figure 31).

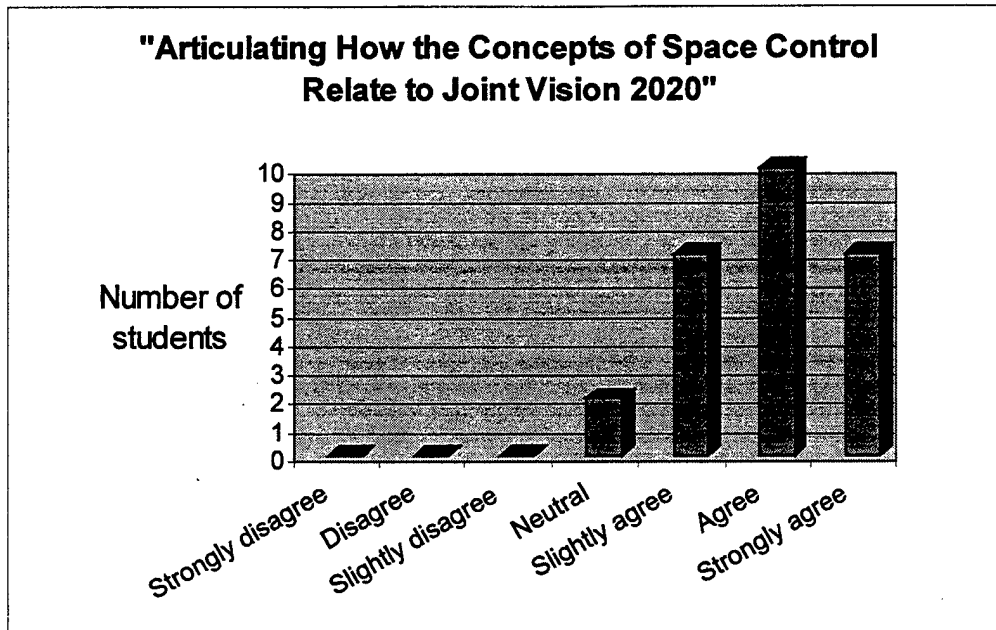


Figure 31. Distribution of the Responses to the Fifth Statement.

N = 26	Mean = 5.85	Median = 6
Minimum = 4	Maximum = 7	Mode = 6

Four correlations were significant, two on other learning objectives in this module, and two on the comfort level with accessing the Internet and with sending e-mail (Table 31). Interpretation is not easy, but students with higher comfort levels with basic technical tools in the DL course should be expected to be more successful in this kind of learning environment.

The sixth statement was 'Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum'. Responses were favorable, without 'disagree' responses except only one student. Figure 32 shows the distribution of the responses. Similarly to other statements in this set, there are few significant correlations – two with variables from this same set of statements, one with

variable from the first questionnaire, and one with the number of visits to the course homepage (Table 32).

Instrument	Statement / Variable	ρ	p value
Module 14	6 – ‘Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum.’	0.525	0.006
Module 14	7 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.448	0.022
Module 14	8 – ‘How would you rate your comfort level at this point with accessing the Internet?’	0.416	0.035
Module 14	9 – ‘How would you rate your comfort level at this point with sending electronic mail?’	0.388	0.050

Table 31. Significant Correlations and Levels of Significance between the Fifth Statement and Other Variables (Ordered by Level of Significance).

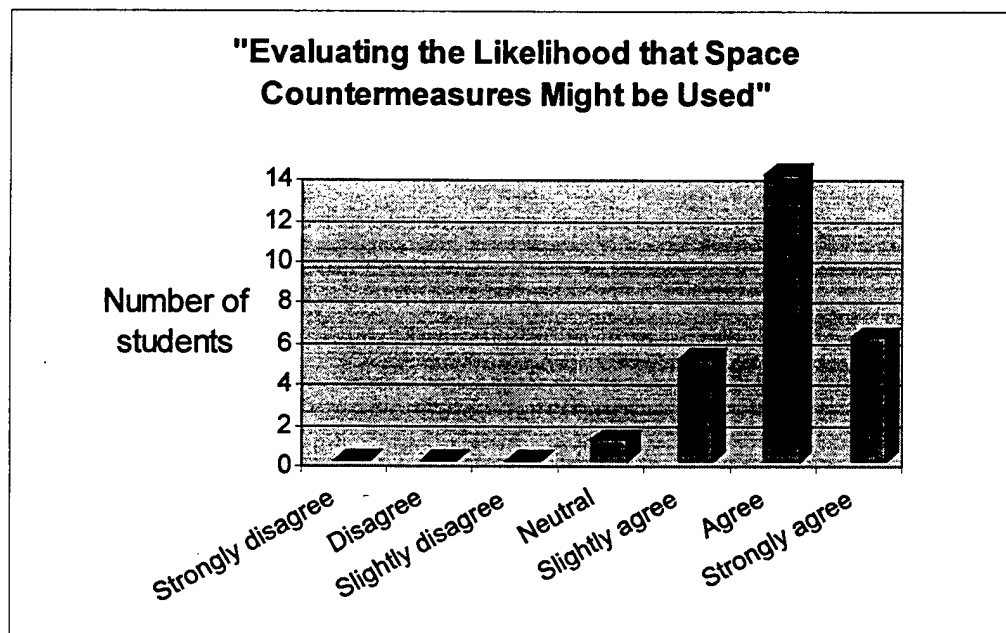


Figure 32. Distribution of the Responses to the Sixth Statement.

N = 26	Mean = 5.96	Median = 6
Minimum = 4	Maximum = 7	Mode = 6

Instrument	Statement / Variable	ρ	p value
Module 14	7 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.579	0.002
Module 14	5 - ‘Articulating how the concept of space control relates to Joint Vision 2020.’	0.525	0.006
Student tracking	Number of visits to course homepage	0.408	0.025
Fist questionnaire	‘How would you rate your on-line search resources and techniques?’	0.367	0.046

Table 32. Significant Correlations and Levels of Significance between Sixth Statement and Other Variables (Ordered by Level of Significance).

The last statement in this set was: ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’ Figure 33 shows the distribution of the responses, which are in this case also very favorable with only one student disagreeing slightly. Significant are the correlations with two other statements from this set: the self-perceived on-line search skills from first questionnaire and the comfort level with the links feature (Table 33).

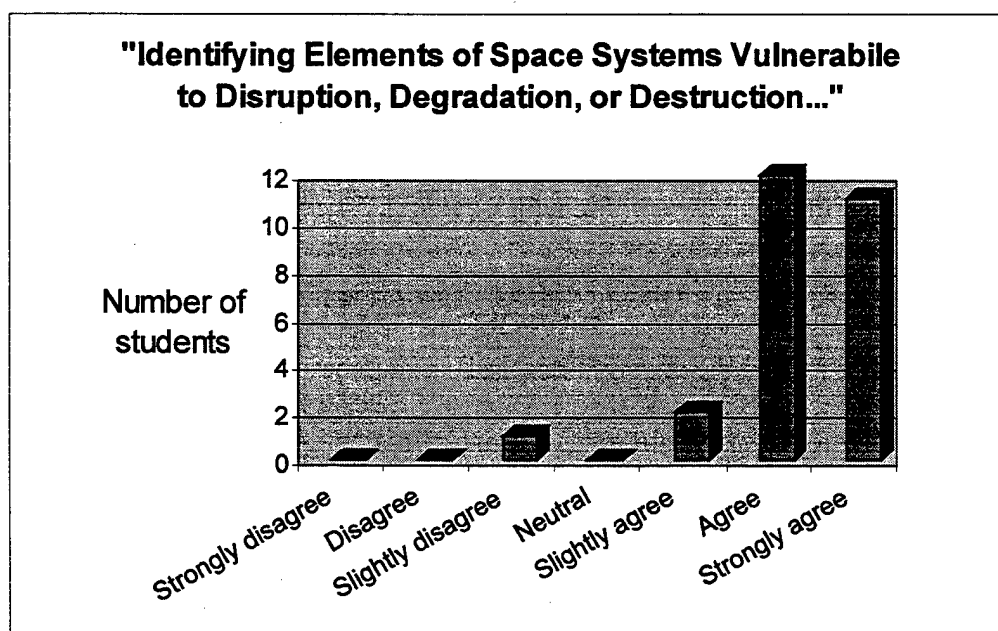


Figure 33. Distribution of the Responses to the Seventh Statement.

N = 26 Mean = 6.23 Median = 6
 Minimum = 3 Maximum = 7 Mode = 6

Instrument	Statement / Variable	ρ	p value
Module 14	6 – ‘Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum.’	0.579	0.002
Module 14	5 - ‘Articulating how the concept of space control relates to Joint Vision 2020.’	0.448	0.022
Fist questionnaire	‘How would you rate your on-line search resources and techniques?’	0.398	0.030
Module 14	12- ‘How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?’	0.398	0.044

Table 33. Significant Correlations and Levels of Significance between the Seventh Statement and Other Variables (Ordered by Level of Significance).

The first set of statements was followed by six questions on the comfort level with different features used in the course. These questions are similar or identical to the question used in Questionnaire A-2 so that comparisons are possible. The eighth item in the questionnaire asked students about their comfort level with accessing the Internet (Figure 34).

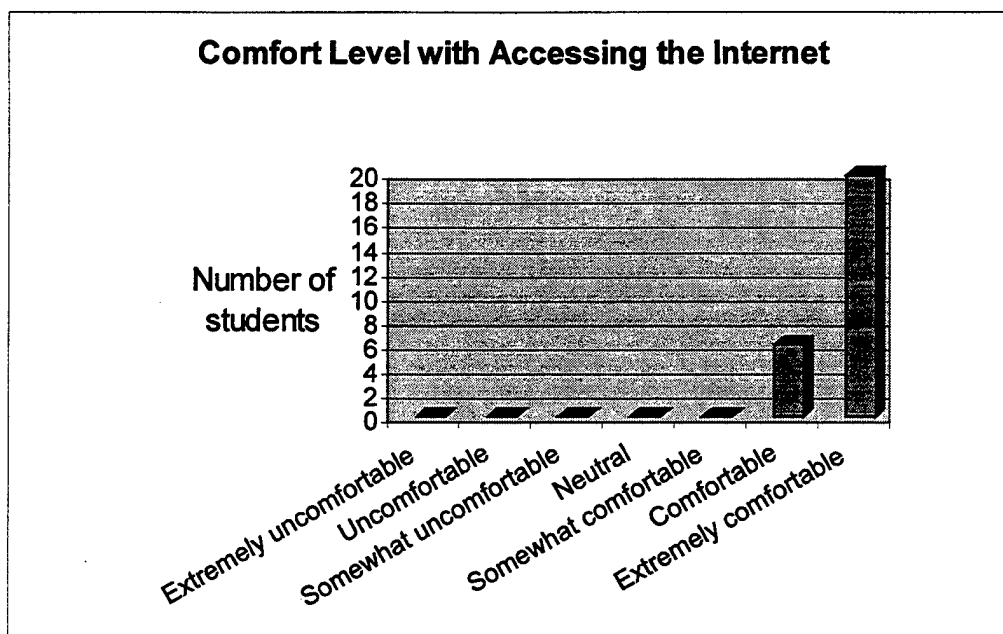


Figure 34. Distribution of the Responses to the Eighth Statement.

N = 26	Mean = 6.77	Median = 7
Minimum = 6	Maximum = 7	Mode = 7

This distribution is very similar to responses to the identical question in the A-2 questionnaire (Figure 11). As in responses to the same question in A-2, significant correlations are high and numerous (Table 34, compare to Table 13). On both occasions, when this question was asked, the highest correlations were with the comfort level with links, use of e-mail, and postings to forums. In this questionnaire there are some variables not present in the data analysis in the A-2 questionnaire such as the set of questions about features used in the course (rules of engagement, module objectives, and on-line student tracking data). Some of the variables from these sets also appeared to be statistically significant, including three indicators from student tracking.

Instrument	Statement / Variable	ρ	p value
Module 14	12- 'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.794	< 0.001
Module 14	9 – 'How would you rate your comfort level at this point with sending electronic mail?'	0.778	< 0.001
Module 14	11 – 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.695	< 0.001
Module 14	10 – 'How would you rate your comfort level at this point with posting comments to the Forums?'	0.656	< 0.001
Module 14	13 – 'Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.'	0.653	< 0.001
Student tracking	Number of visits to homepage	0.475	0.005
Student tracking	Number of articles read	0.461	0.010
Module 14	1 - 'Identifying key elements of Space Control.'	0.470	0.015
Student tracking	Total number of hits	0.425	0.019
Module 14	5 - 'Articulating how the concept of space control relates to Joint Vision 2020.'	0.406	0.035

Table 34. Significant Correlations and Levels of Significance between the Eighth Statement and other Variables (Ordered by Level of Significance).

The next question was about the comfort level with sending e-mail (Figure 35). Now all the students felt comfortable or extremely comfortable sending e-mail, which was not the case in the A-2 questionnaire (Figure 14), where three students expressed they felt somewhat (one student) or even extremely uncomfortable (two students).

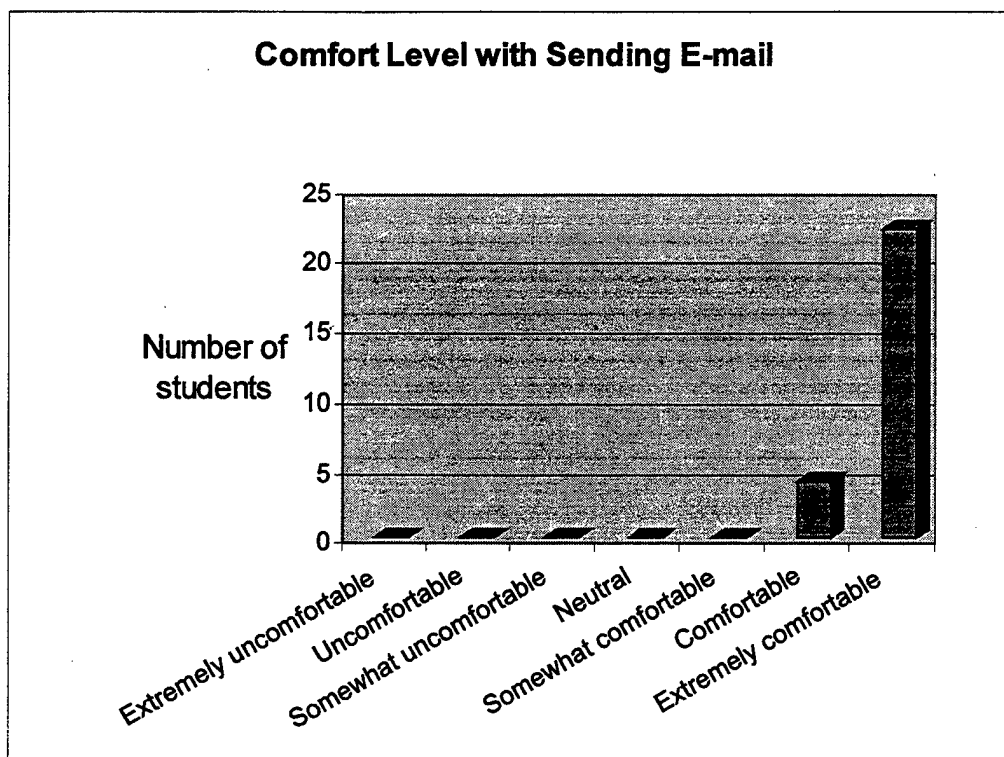


Figure 35. Distribution of the Responses to the Ninth Statement.

N = 26	Mean = 6.85	Median = 7
Minimum = 6	Maximum = 7	Mode = 7

The dominant issues with the highest correlations seem to be different than in the A-2 questionnaire (Table 35 below, compare with Table 15). In the latter case, the highest correlation was with the comfort level with word processing, which is not significant in this questionnaire. There are also some other variables that are statistically significant such as four correlations with on-line tracking indicators. Correlations with the on-line tracking data indicate that students more comfortable with sending e-mail tend to read more articles, visit the course homepage more often, post more articles, and in general visit on-line course material more frequently. Overall, comfort level with sending e-mail seems to be important for student achievement in the course.

The next question was: ‘How would you rate your comfort level at this point with posting comments to the Forums?’ Figure 36 shows the distribution of the responses. Twelve students (46.15%) felt ‘extremely comfortable’ with posting to the forums, two students (7.69%) felt ‘somewhat comfortable’, and two even ‘somewhat uncomfortable’. Compared to the distribution of the responses to a similar question in A-2 questionnaire (Figure 13), this distribution shows that the comfort level improved during the course.

Instrument	Statement / Variable	ρ	p value
Module 14	8 – ‘How would you rate your comfort level at this point with accessing the Internet?’	0.778	< 0.001
Module 14	13 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.662	< 0.001
Module 14	11 – ‘How would you rate your comfort level at this point with quiz feature being used to teach this course?’	0.600	0.001
Module 14	10 – ‘How would you rate your comfort level at this point with posting comments to the Forums?’	0.567	0.003
Module 14	12- ‘How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?’	0.531	0.005
Module 14	1 - ‘Identifying key elements of Space Control.’	0.494	0.010
Student tracking	Number of articles read	0.420	0.021
Student tracking	Number of visits to homepage	0.400	0.029
Student tracking	Number or articles posted	0.398	0.030
Student tracking	Total number of hits	0.387	0.034
Module 14	5 - ‘Articulating how the concept of space control relates to Joint Vision 2020.’	0.388	0.050

Table 35. Significant Correlations and Levels of Significance between the Ninth Statement and Other Variables (Ordered by Level of Significance).

Similar items appear on the list of highly correlated variables, and correlations with five student tracking indicators are statistically significant also (Table 36 below, compare with Tables 14 and 19).

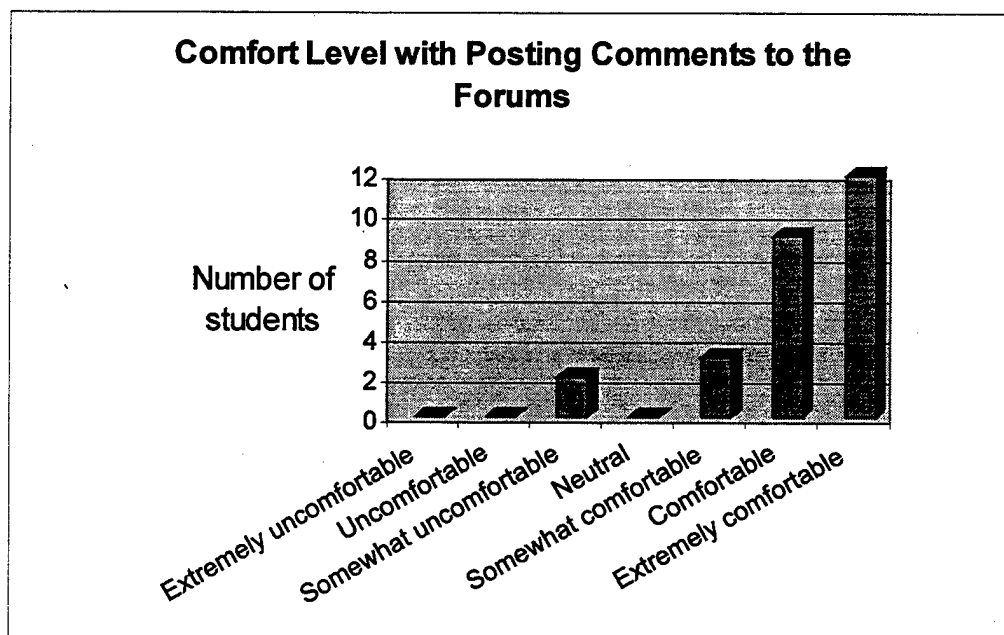


Figure 36. Distribution of the Responses to the Tenth Statement.

N = 26	Mean = 6.12	Median = 6
Minimum = 3	Maximum = 7	Mode = 7

A question on the comfort level with the quiz feature was next. The distribution of the responses (Figure 37) had much more responses about high comfort level than in the questionnaire A-2 (Figure 21). However, this change is not only due to the learning process and improving one's own skills in the course, but also due to the fact that technical problems such as 'bugs' in software were fixed after the A-2 was administered.

This variable has numerous significant correlations with other variables (Table 37), including six student tracking indicators and final grades. The instructor did not

include quiz scores in the final grade, but the correlation, even though not high¹², is evident. Also, there are similarities to correlations in the A-2 question about the quiz feature. Compare it to Table 23.

Instrument	Statement / Variable	ρ	p value
Module 14	11 – ‘How would you rate your comfort level at this point with quiz feature being used to teach this course?’	0.687	< 0.001
Module 14	13 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.669	< 0.001
Module 14	8 – ‘How would you rate your comfort level at this point with accessing the Internet?’	0.656	< 0.001
Module 14	9 – ‘How would you rate your comfort level at this point with sending electronic mail?’	0.567	0.003
Module 14	12- ‘How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?’	0.565	0.003
Student tracking	Number of original posts	0.485	0.007
Student tracking	Total number of hits	0.441	0.015
Student tracking	Number or articles posted	0.416	0.022
Student tracking	Number of visits to homepage	0.406	0.026
Student tracking	Number of articles read	0.373	0.043

Table 36. Significant Correlations and Levels of Significance between the Tenth Statement and Other Variables (Ordered by Level of Significance).

¹² By ‘high’ correlation statisticians usually mean values over 0.75 or 0.80.

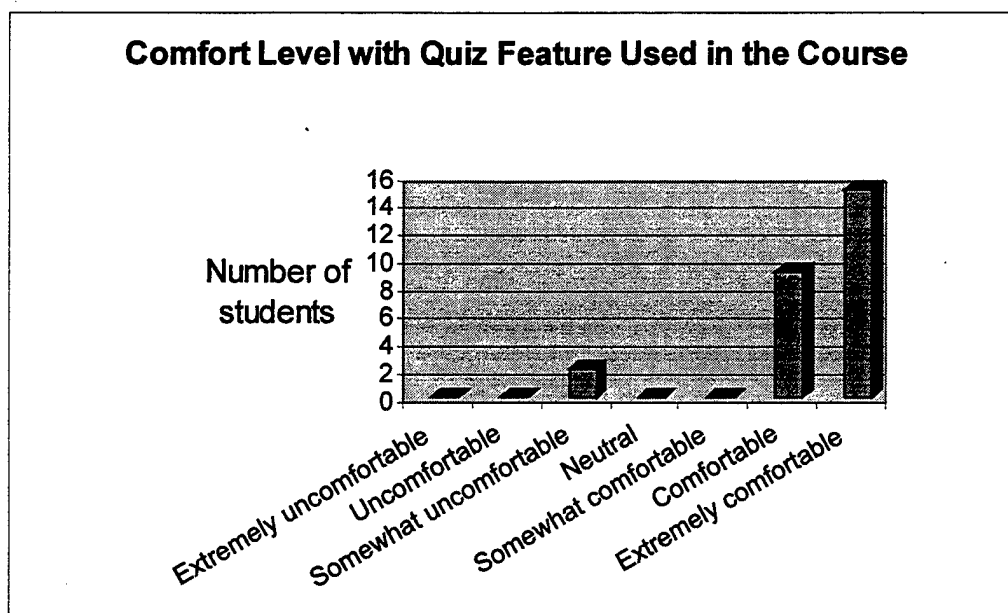


Figure 37. Distribution of the Responses to the Eleventh Statement.

N = 26	Mean = 6.35	Median = 7
Minimum = 3	Maximum = 7	Mode = 7

The question about the links feature has the highest percent of 'extremely comfortable' responses – 76.92% (Figure 38). Only one student felt 'somewhat uncomfortable' with the links used in the course. Similar responses about this feature were in questionnaire A-2 (Figure 17), but with one 'extremely uncomfortable' response. There is only one very high correlation (Table 38) with the comfort level in accessing the Internet. This is logical because problems with access certainly cause many other problems in using the course features, which includes links, but the other five correlations were statistically significant also. Interestingly, the number of significant correlations was higher in A-2 questionnaire (Table 22).

Instrument	Statement / Variable	ρ	p value
Module 14	8 – ‘How would you rate your comfort level at this point with accessing the Internet?’	0.695	< 0.001
Module 14	10 – ‘How would you rate your comfort level at this point with posting comments to the Forums?’	0.687	< 0.001
Module 14	9 – ‘How would you rate your comfort level at this point with sending electronic mail?’	0.600	0.001
Student tracking	Total number of hits	0.581	0.001
Module 14	13 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.542	0.004
Student tracking	Number of articles posted	0.497	0.005
Student tracking	Number of articles read	0.466	0.009
Student tracking	Number of visits to homepage	0.449	0.013
Module 14	12- ‘How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?’	0.475	0.014
	FINAL GRADE	0.465	0.017
Student tracking	Number of original posts	0.427	0.019
Module 14	1 - ‘Identifying key elements of Space Control.’	0.440	0.024
Student tracking	Number of follow-up posts	0.411	0.024

Table 37. Significant Correlations and Levels of Significance between the Eleventh Statement and Other Variables (Ordered by Level of Significance).

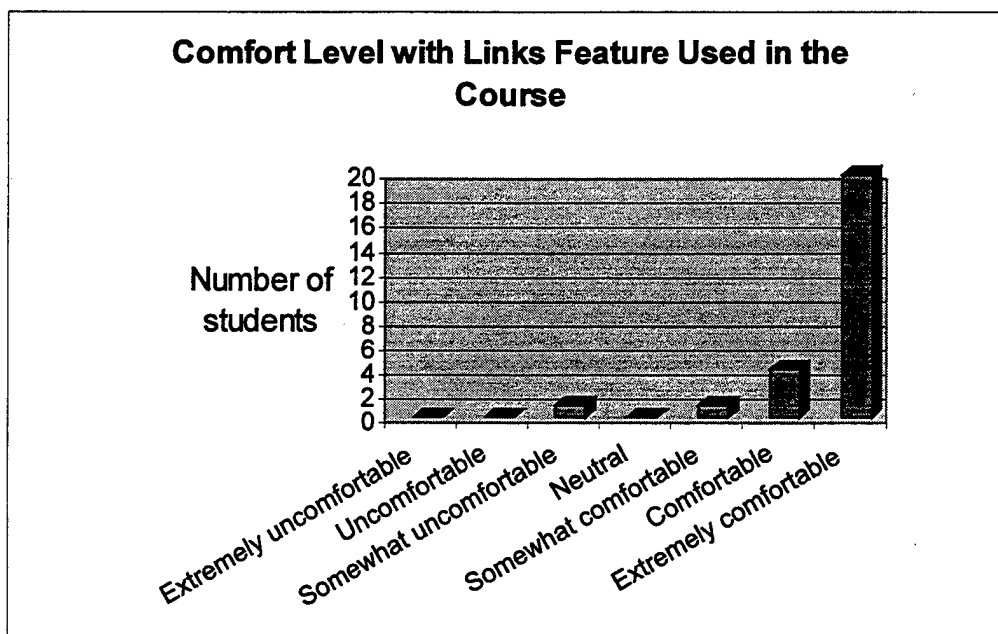


Figure 38. Distribution of the Responses to the Twelfth Statement.

N = 26	Mean = 6.62	Median = 7
Minimum = 3	Maximum = 7	Mode = 7

The students responded to the thirteenth question about the comfort level with word processing in a similar manner as the comfort level with links used in the course. The vast majority (twenty students or 76.92%) felt extremely comfortable, which is what is expected from students at NPS (Figure 39). This distribution shows slightly higher student comfort level than results in the second questionnaire (compare Figure 7). Again, there were many significant correlations with other variables such as those asking about comfort level with forums, finals grades, e-mail, accessing the Internet etc., and with five student tracking indicators (Table 39). The comfort level with word processing seems to be very indicative of students' 'broad technical proficiency', which is so important in a DL environment. A similarity about correlations between such variables is present in the A-2 questionnaire (Table 14).

Instrument	Statement	ρ	p value
Module 14	8 – ‘How would you rate your comfort level at this point with accessing the Internet?’	0.794	< 0.001
Module 14	10 – ‘How would you rate your comfort level at this point with posting comments to the Forums?’	0.565	0.003
Module 14	9 – ‘How would you rate your comfort level at this point with sending electronic mail?’	0.531	0.005
Module 14	11 – ‘How would you rate your comfort level at this point with quiz feature being used to teach this course?’	0.475	0.014
Module 14	13 – ‘How would you rate your comfort level at this point with word processing?’	0.445	0.023
Module 14	7 – ‘Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries.’	0.398	0.044

Table 38. Significant Correlations and Levels of Significance between the Twelfth Statement and Other Variables (Ordered by Level of Significance).

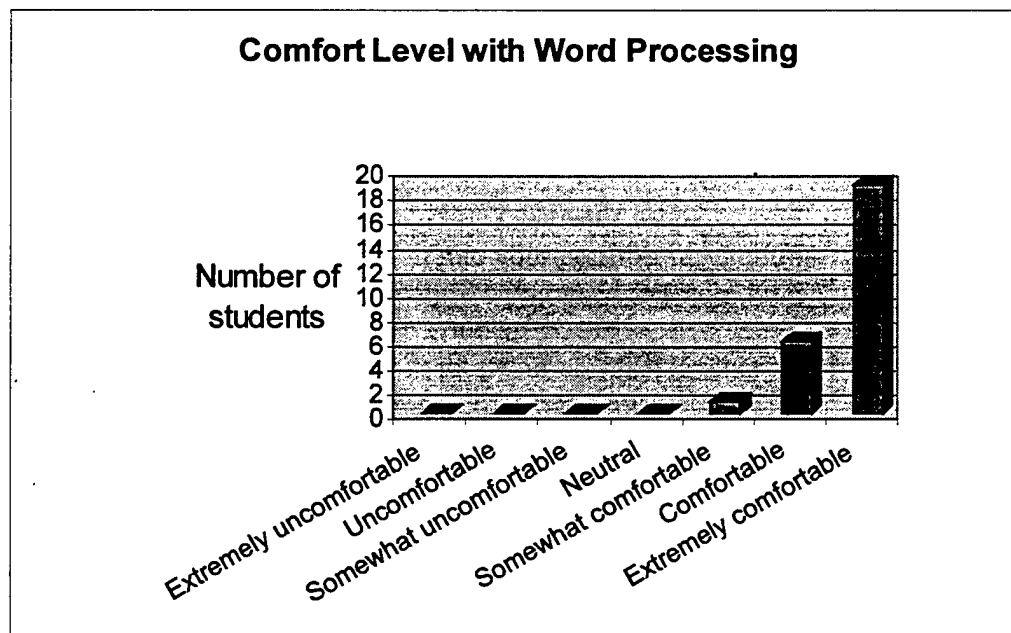


Figure 39. Distribution of the Responses to the Thirteenth Statement.

N = 26

Median = 7

Minimum = 5

Maximum = 7

Mode = 7

Instrument	Statement / Variable	ρ	p value
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	0.669	< 0.001
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	0.662	< 0.001
Module 14	8 - 'How would you rate your comfort level at this point with accessing the Internet?'	0.653	< 0.001
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	0.542	0.004
Student tracking	Number of articles posted	0.501	0.005
Student tracking	Number of articles read	0.478	0.008
	FINAL GRADE	0.441	0.015
Module 14	12- 'How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course?'	0.445	0.023
Student tracking	Number of original posts	0.412	0.024
Student tracking	Number of follow-up posts	0.407	0.026
Student tracking	Total number of hits	0.404	0.027

Table 39. Significant Correlations and Levels of Significance between the Thirteenth Statement and other Variables (Ordered by Level of Significance).

The last question in the Module 14 questionnaire was open-ended, thereby giving students an opportunity to add comments. The comments varied from simple and positive to rather complex. The students also gave suggestions for course improvements. Here are the comments grouped into five types:

Positive comments

- This course is a great for keeping up on current events, as well as keeping our interest in the topic by linking us to good web resources
- I enjoyed the course! I look forward to seeing more courses. I feel this is the beginning of some great opportunities for troops who would not otherwise be able to take classes due to location or OPTEMPO.

- This was my first online course and I truly enjoyed it. On-line courses take a great deal of personal commitment and focus. Providing an interesting subject and stimulating discussion helps to increase participation.
- Having no prior courses in space systems, I did not know what to expect. I am amazed at how much our military (as well as everyday life) is dependent on space systems. This especially comes as a surprise having been on 4 WESTPAC deployments and not being aware of what's going on "up there". It all seemed so transparent... not anymore. I appreciate this great course, which will ensure I will continue to educate myself about space systems.
- Honestly, if I was a space guy, I might not have gotten a great deal for this course and wouldn't have been challenged. As it is, I'm an ITM guy and feel that I received a great overview of Space, the systems involved, how the systems relate to the military, etc. I'll admit it; I actually enjoyed the course and looked forward to reading the articles and postings. This definitely would not have been the case if I'd been forced into learning a lot of math that I would never use again (and would thus drop out of my brain's RAM as soon as the quarter was over).
- As I stated in my written SOF, had testing occurred weekly, it probably would have kept me in the books/readings with more consistency. The readings were very interesting...much more so than the text.... Some of the text concepts (orbits) were difficult to understand without direct classroom instruction... Overall, a good experience.

Positive comments, mentioning some problems

- Although I enjoyed the flexibility of the on-line course, I am frustrated with the content. There were no technical discussions or material provided in the forums or quizzes. The required understanding of the material was rudimentary at best. If this was meant as an introductory course, then it met the requirement. If it was meant as a technical course, then it fell way short.
- This course is a good example of what you can do in an Internet course. I thought the forum played a good role in student interaction. The loss of the ability to quiz on later sections did tend to demotivate. I know it should be more than grades and testing, but with our schedules, you do what you are tested on. All around the course was a good experience.
- Outstanding links were provided to support objectives of each module. Very thoughtful, innovative, and interesting presentations. The class seemed to get a little off-track when the system kept going down, but made a strong finish. System reliability is a problem that needs to be addressed. Perhaps a backup server at a different location. I really enjoyed this class.

- I think there is still plenty of room for improvement. Network downtime and glitches interrupted the flow of the course. I believe the Quizzes for each module are a necessity. While they are a pain in the rear, they really force you to keep up with the material...once the quizzes tapered off... It is easy to get behind. The quizzes don't have to be big...just enough to keep you honest. Other than that I think the course has great potential for learning.

Some ideas and suggestions

- Would like to see a "What's New" page every time I log on so I can instantly see what is happening relative to bug fixes, or new enhancements, etc. Also would like an email feature that would let me know when someone replied to a forum posting of my own.
- I think there should be quizzes after each module to keep us on our toes! Aside from that, it was a very interesting course.
- I think that forums every week, in small groups that change, would have drastically increased my consistent participation in the course. I would even say that part of the individual grade for a student would be made up of the average grade of all the groups he or she belonged to. Nothing like a little peer-pressure to get a group to encourage itself (member to member e-mails or whatever).

Skeptics

- An on-line course will never provide the same quality of instruction as an actual in class course. I do not feel like I got more than a cursory knowledge of the material covered. The on-line format is adequate for training type courses- not education. To improve the class, there should be at least one class meeting per week (with VTC if required). All modules should be available at all times in order to work at your own pace and get ahead when you can. In the future, I will be much more less inclined to take an on-line class. If this is the wave of the future, our educational system is in bigger trouble than we think.
- I felt I would have gotten more from a traditional course. I understand there were some technical problems with the course but I believe the face-to-face contact, at least occasionally is really necessary.

Complex comments

- The course was difficult to complete online. Classroom interface was needed. I think maybe adding a Chat Room and class meeting time would help get a better understanding of what was required. The emails were

great help to keep me on track. However, the emails were late in support of the modules. The modules were too dynamic for me to follow. I think the web site should put old modules or incorrect data on the web site. Most of the Quizzes didn't work correctly. My quiz grade is still messed up. The interface with a keyboard is slow and painful. Spell check and grammar check would help. I did learn a lot about space systems from the links. At this point I would not hire a person with a degree earn online. The student work is hard to verify. Think of adding a private chat room for instructor to student test. Online Questions could be asked in a private chat as a test question.

- I would have enjoyed this class more if it were my only class. It was a serious time HOG when it came to posting messages. What you could do in 2 minutes discussing all the point, it would take 45 minutes to an hour to write a well-articulated point paper... I think messages should be limited to 7/8 sentences max. Some people wrote books, which subconsciously made the stakes higher for everyone in trying to write something unique. Format of message post...to aid reading, users must write 3/4 sentences and put a break and start on the next line. This should be in the rules of engagement. Too many posts ran forever all together, and made it difficult to read. The whole forum message board is not extremely intuitive. I have it figured out but there are a lot of menu items. Unsure as to you could do to improve. Personally, I liked the online quizzes. Learning does take place when taking them. Bugs need to be worked out. Frustrating when the quizzes did not score correctly initially.
- Strong points:
 - o The information provided on the web site was excellent. The links were informative and rich with both interesting and relevant information. Most definitely, the best part of the course.
 - o The forums allowed for an exchange of ideas. It's a good way to learn.
- Weak points:
 - o I could have done without the textbook. The website provided all the book had and more. I really don't think there's a need for a textbook.
 - o The forums weren't really a hotbed of new ideas or even an exploration of old ideas. In the future, some method of more regular interaction should be developed.
- Overall:
 - o It is very obvious that a great deal of work and time went into developing this course. I think many of the bugs experienced during this quarter for this course were temporary. This will be one heck of a course (on-line or otherwise) when everything is up and running!
 - o

Module 14 Questionnaire – Summary

This on-line questionnaire was administered after module 14. In total 15 modules were covered in the course. This questionnaire was not anonymous; twenty-six students completed it.

There were three groups of questions/statements. The first seven were designed by the instructor to see how well the module 14 learning objectives were being met. The next six questions asked the students about their comfort level with relevant 'technical' issues and features used in the course such as accessing the Internet, sending e-mail, posting comments to forums, completing the quiz feature used in the course, using the links feature and lastly, using word processing. The last question was open-ended; students had an opportunity to add any comments or additional thoughts.

Responses to the first seven statements were predominantly positive, but with slightly different distributions. Some statements had a very high number of 'agree' and 'strongly agree' responses, and some others had a significant number of 'disagree' responses. In general, the students responded that all module objectives were more or less met to a very satisfactory degree.

Responses about comfort levels with features mentioned above are very similar to the responses to the corresponding questions in the Second questionnaire (A-2), but with increased overall comfort level. Student on-line tracking indicators and some items from the First questionnaire had significant correlations with several questions in this questionnaire, like questions about comfort level with accessing the Internet, with sending e-mail, with posting to forums, etc.

The student comments provided many interesting comments, which were grouped into the following content types: positive comments (six students); positive comments with mentioning some problems (four); ideas and suggestions (three); complex comments (three); and 'skeptics' (two students). Seven students did not add any comments.

4. Final Survey

This on-line questionnaire was administered after the course was completed, after the final exam. However, it was administered before the she instructor gave final grades to the students. It was anonymous. Twenty-three students completed it.

The thirty-one items included:

- Questions reflecting course objectives
- Two questions on student self-confidence in certain activities relevant to the course
- Several questions on the usefulness of different features used in the course in terms of helping the student to understand the course concepts, objectives, and principles; four questions asking the students how much they liked some of the activities and materials in the course
- Four questions about interactivity between the students and the instructor
- Some other specific questions included open-ended questions
- Long-Dziuban's Reactive Behavior Protocol

There were five open-ended questions in this questionnaire.

The first question asked the students the following: 'As a result of your overall experience in this course, do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?' Figure 40 shows how the students responded.

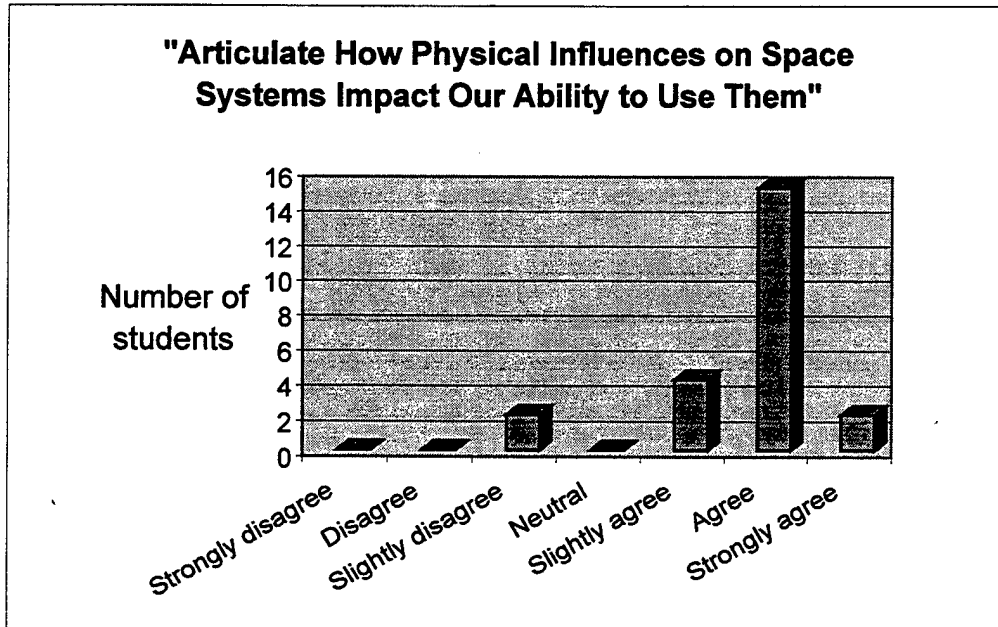


Figure 40. Distribution of the Responses to the First Question.

N = 23	Mean = 5.65	Median = 6
Minimum = 3	Maximum = 7	Mode = 6

Most of the students (nineteen out of twenty-three or 82.61%) clearly agreed they've become able to articulate space system issues. Responses to this question significantly correlate with affective reactions, the module readings usefulness question, self-confidence in discussing and in accessing resources, and the quality of interaction between the students and the instructor (Table 40). Seven correlations have p under 0.01, i.e., 1%.

The second question was: 'As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?' Responses to this question (Figure 41) were similar to the first one, but all were positive and only one was neutral. Seven correlations were statistically significant (Table 41).

Statement / Variable	ρ	p value
17 – ‘How did you like the website links that were provided?’	0.629	0.001
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.596	0.003
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.592	0.003
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.585	0.003
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.550	0.007
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.538	0.008
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.540	0.008
26 – ‘Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar ‘face-to-face’ class.’	0.429	0.041

Table 40. Significant Correlations and Levels of Significance between the First Question and Other Variables (Ordered by Level of Significance).

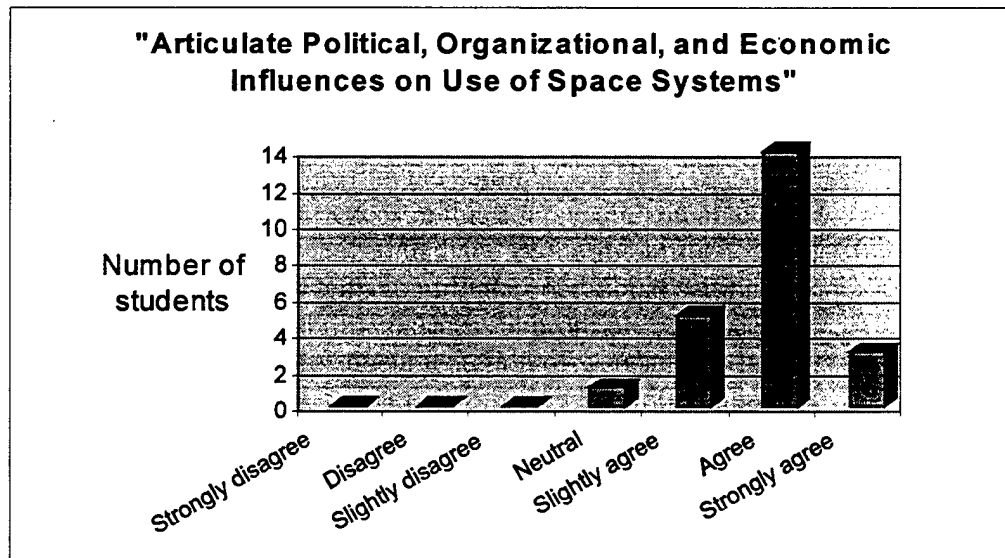


Figure 41. Distribution of the Responses to the Second Question.

N = 23

Mean = 5.83

Median = 6

Minimum = 4

Maximum = 7

Mode = 6

Statement / Variable	ρ	p value
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.782	< 0.001
20 – ‘I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.’	0.634	0.001
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.633	0.001
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.585	0.003
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.538	0.008
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.494	0.016
11 – ‘How useful were the linked websites in helping you to understand the course concepts, objectives and principles?’	0.476	0.022

Table 41. Significant Correlations and Levels of Significance between the Second Question and Other Variables (Ordered by Level of Significance).

The third question was: ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’ Figure 42 shows how the responses were distributed. Ten students (43.48%) responded with ‘strongly agree’, eight (34.78%) with ‘agree’, and five (21.74%) with ‘slightly agree’. None were neutral or disagreed. Six correlations were statistically significant (Table 42). The listed statements/questions dealt with the issues of different student abilities and with students’ view of the usefulness of module readings.

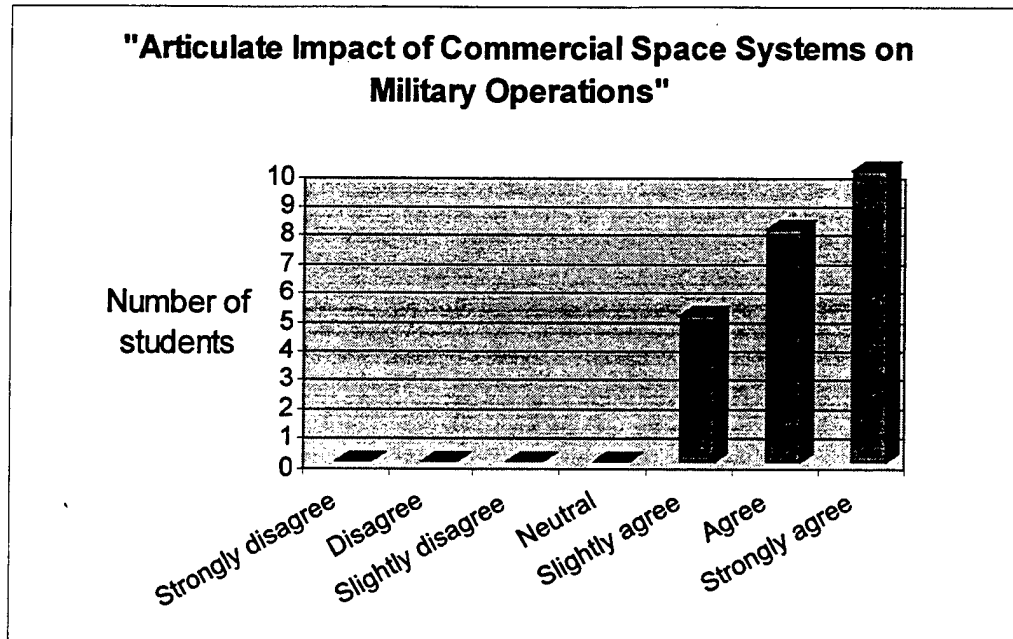


Figure 42. Distribution of the Responses to the Third Question.

N = 23	Mean = 6.21	Median = 6
Minimum = 4	Max = 7	Mode = 7

The fourth question asked students: 'Was the final exam useful in helping you to synthesize the concepts learned in the course?' Figure 43 shows the responses. Four students (17.39%) thought the exam was not useful. Only three (13.04%) believed the exam was extremely useful. Table 43 shows the variables that had significant correlations to this question responses. The variables listed in the table include three 'affective reaction' (liking) type questions and one question on course interactivity.

Statement / Variable	ρ	p value
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.782	< 0.001
20 – ‘I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.’	0.605	0.002
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.602	0.002
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.592	0.003
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.588	0.003
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.557	0.006

Table 42. Significant Correlations and Levels of Significance between the Third Question and Other Variables (Ordered by Level of Significance).

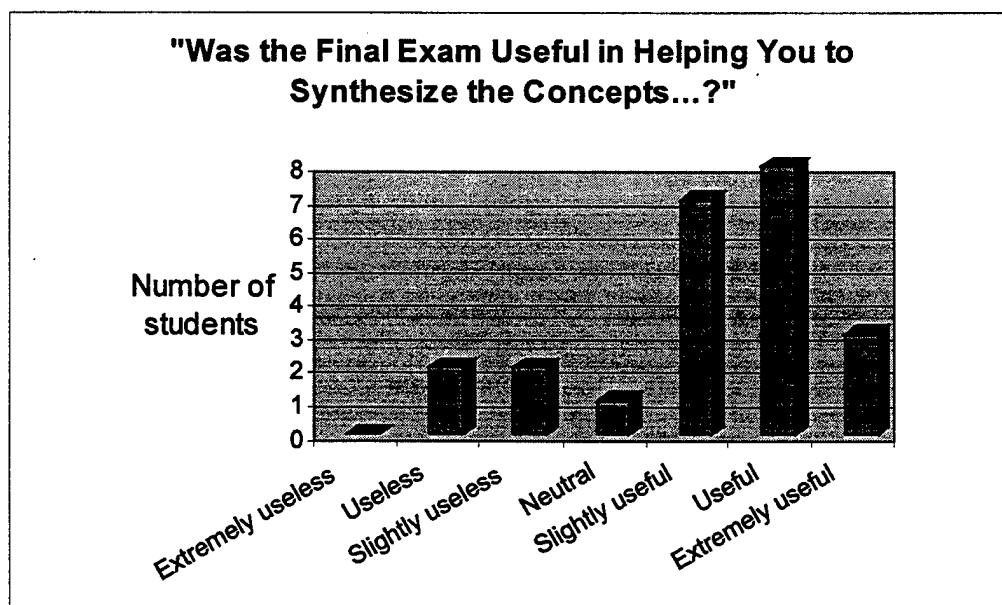


Figure 43. Distribution of the Responses to the Fourth Question.

N = 23

Mean = 5.13

Median = 5

Minimum = 2

Max = 7

Mode = 6

Statement / Variable	ρ	p value
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.537	0.008
25 – ‘Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar ‘face-to-face’ class.’	0.523	0.011
8 – ‘How useful were guidelines provided at the course homepage for posting substantive responses to the Forums?’	0.506	0.014
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.503	0.014
24 – ‘Compare the amount of interaction you had with the instructor for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.456	0.029
17 – ‘How did you like the website links that were provided?’	0.453	0.030
16 – ‘How did you like the Module readings?’	0.434	0.039
15 – ‘How did you like the textbook reading assignments?’	0.428	0.042
12 – ‘How useful were the Forum exercises in helping you to understand the subject matter?’	0.422	0.045

Table 43. Significant Correlations and Levels of Significance between the Fourth Question and Other Variables (Ordered by Level of Significance).

The fifth question addressed the students’ confidence: ‘I feel confident in my ability to access appropriate resources; such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’ Most of the students (nine or 39.13%) chose the response ‘agree’, and none disagreed (Figure 44). The highest correlation this variable had was with another question about confidence (Table 44). In total, eight correlations were statistically significant.

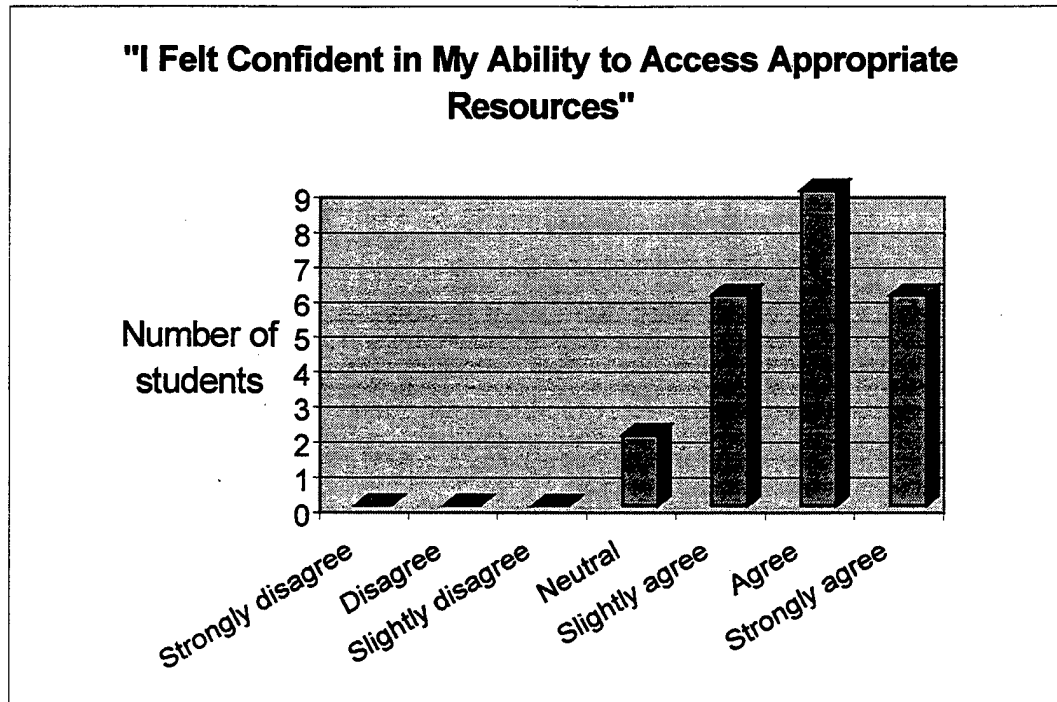


Figure 44. Distribution of the Responses to the Fifth Question.

N = 23

Mean = 5.83

Median = 6

Minimum = 4

Max = 7

Mode = 6

The sixth question asked: 'I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.' Figure 45 shows how the responses were distributed and a slight agreement (nine responses or 39.13%) with the statement dominated. Table 45 lists seven variables that significantly correlate with the responses to this statement.

Statement / Variable	ρ	p value
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.736	< 0.001
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.557	0.006
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.540	0.008
20 – ‘I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.’	0.509	0.013
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.494	0.016
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.482	0.020
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.444	0.034
16 – ‘How did you like the Module readings?’	0.436	0.038

Table 44 Significant Correlations and Levels of Significance between the Fifth Question and Other Variables (Ordered by Level of Significance).

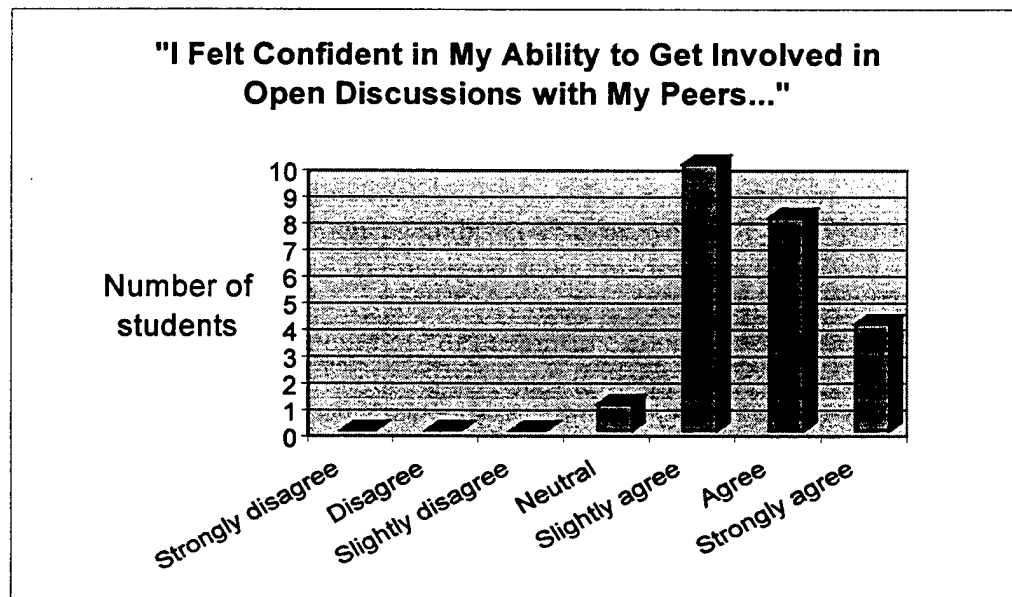


Figure 45. Distribution of the Responses to the Sixth Question.

N = 23

Mean = 5.65

Median = 6

Minimum = 4

Max = 7

Mode = 5

Statement / Variable	ρ	p value
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.736	< 0.001
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.633	0.001
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.602	0.002
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.564	0.005
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.555	0.006
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.550	0.007
20 – ‘I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.’	0.478	0.021

Table 45. Significant Correlations and Levels of Significance between the Sixth Question and Other Variables (Ordered by Level of Significance).

The seventh question and the distribution of the responses are in Figure 46. Asked about usefulness of the guidelines on the course homepage, few students (two or 8.70%) chose the response ‘useless’, but a majority of the students (twenty students or 86.96%) saw the guidelines as useful. Only one correlation was significant (Table 46), and that was with responses to the question asking about guidelines.

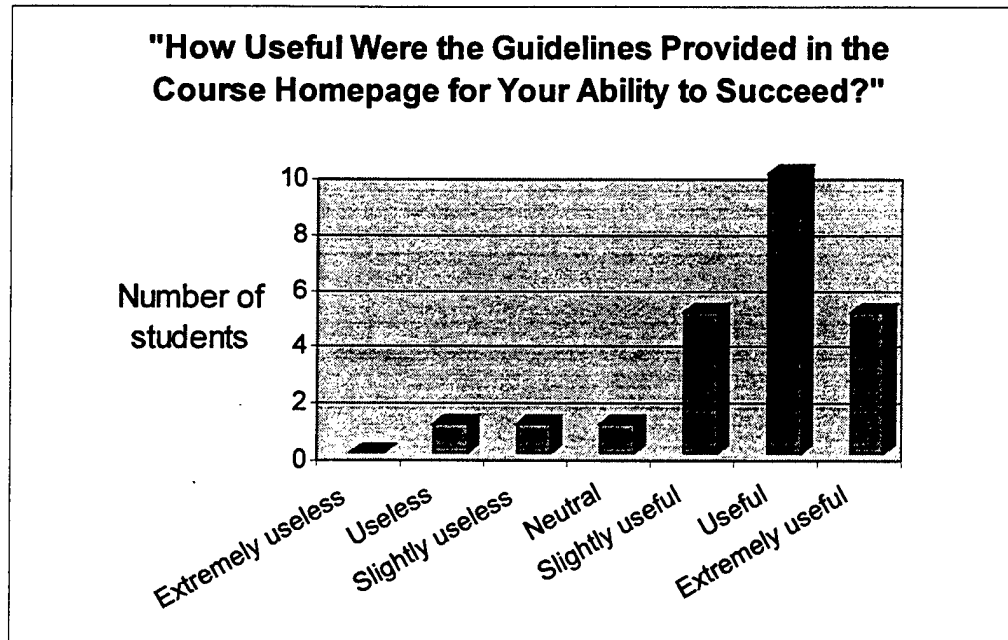


Figure 46. Distribution of the Responses to the Seventh Question.

N = 23

Mean = 5.61

Median = 6

Minimum = 2

Max = 7

Mode = 6

Statement / Variable	ρ	p value
8 – 'How useful were guidelines provided at the course homepage for posting substantive responses to the Forums?'	0.711	< 0.001

Table 46. Significant Correlation and Level of Significance between the Seventh Question and Another Variable.

Student responses to the second question about the guidelines ('How useful were guidelines provided at the course homepage for posting substantive responses to the Forums?') distributed differently than the first question (Figure 47), with more neutral responses (five or 21.74%) and a higher frequency of 'useful' responses (thirteen or 56.53%). Four correlations appeared to be significant (Table 47). Interestingly, the responses to questions about module readings, quizzes, and final exams have significant correlations with responses to this question but to none of the other variables. This is difficult to explain.

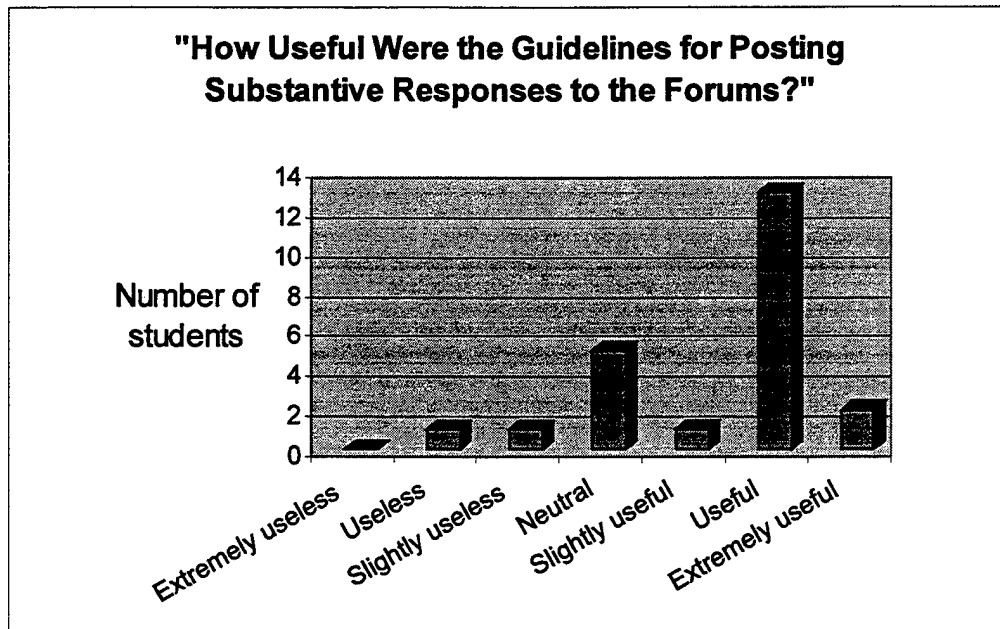


Figure 47. Distribution of the Responses to the Eighth Question.

N = 23 Mean = 5.30 Median = 6
 Minimum = 2 Max = 7 Mode = 6

Statement / Variable	ρ	p value
7 – 'How useful were the guidelines provided in the course homepage to your ability to succeed?'	0.711	< 0.001
16 – 'How did you like the Module readings?'	0.516	0.012
4 – 'Was the final exam useful in helping you to synthesize the concepts learned in the course?'	0.506	0.014
13 – 'How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules?'	0.500	0.015

Table 47. Significant Correlations and Levels of Significance between the Eighth Question and Other Variables (Ordered by Level of Significance).

The ninth question asked students about the usefulness of the textbook: 'How useful was the textbook in helping you understand the course concepts, objectives and principles?' Figure 48 shows the distribution of the student responses. Most of the students (twenty-one students or 91.30%) saw the textbook as useful, but there was one

response 'useless', and one neutral response. Only one correlation was significant (Table 48).

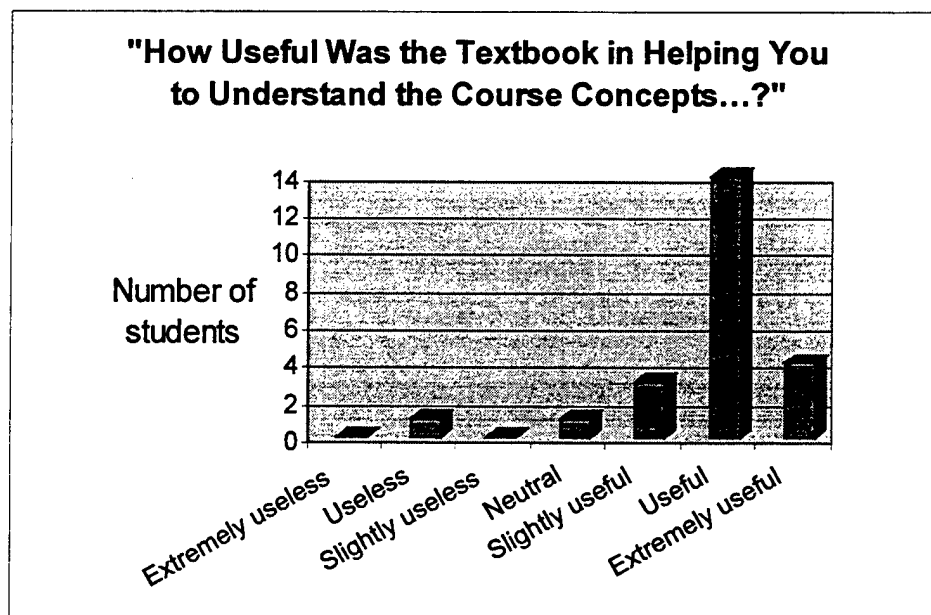


Figure 48. Distribution of the Responses to the Ninth Question.

N = 23	Mean = 6.13	Median = 6
Minimum = 2	Max = 7	Mode = 6

Statement / Variable	ρ	p value
15 – 'How did you like the textbook reading assignments?'	0.636	0.001

Table 48. Significant Correlation and Level of Significance between the Ninth Question and Another Variable.

Most students (fourteen students or 60.87%) saw the on-line module readings as 'extremely useful' (Figure 49). Ten correlations were significant. The correlations and significance levels are in Table 49.

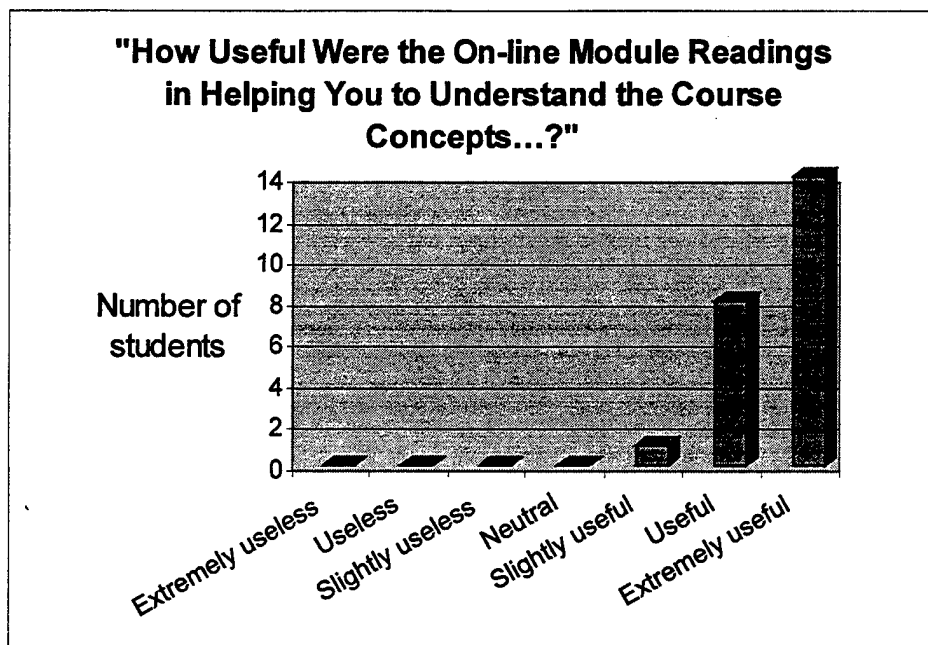


Figure 49. Distribution of the Responses to the Tenth Question.

N = 23

Mean = 6.57

Median = 7

Minimum = 7

Max = 7

Mode = 7

The fifth question asked students: 'How useful were the linked websites in helping you to understand the course concepts, objectives, and principles?' Most students chose to respond with 'useful' (eleven students or 47.83%), and slightly less (ten or 43.48%) with 'extremely useful' (Figure 50).

Only three correlations were significant (Table 50). The highest correlation was with another question related to liking the links feature the course provided. This correlation of approximately 0.56 means that a utility assessment (thinking of usefulness of a feature) and an affective reaction (liking it) have a significant association but are not identical. Otherwise the correlation would be much higher, close to 1. Two other correlations are difficult to interpret. They are correlations with the student responses to statements/questions related to several of the course learning objectives.

Statement / Variable	ρ	p value
17 – ‘How did you like the website links that were provided?’	0.644	0.001
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.596	0.003
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.588	0.003
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.585	0.003
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.564	0.005
16 – ‘How did you like the Module readings?’	0.541	0.008
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.537	0.008
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.536	0.008
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.512	0.012
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.444	0.034

Table 49. Significant Correlations and Levels of Significance between the Tenth Question and Other Variables (Ordered by Level of Significance).

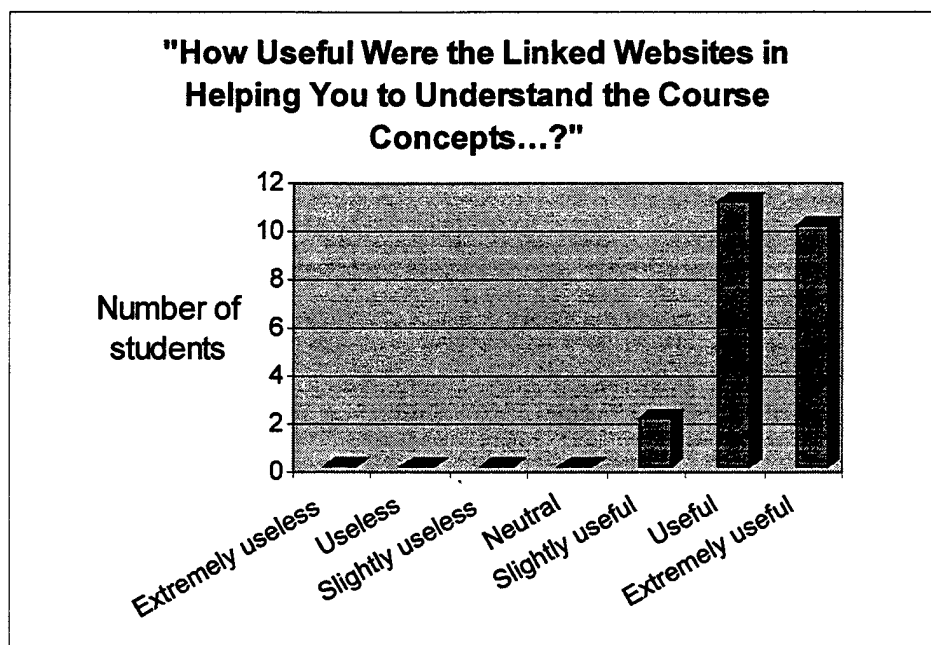


Figure 50. Distribution of the Responses to the Eleventh Question.

N = 23

Mean = 6.35

Median = 6

Minimum = 5

Max = 7

Mode = 6

Statement / Variable	ρ	p value
17 – 'How did you like the website links that were provided?'	0.557	0.006
2 – 'As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?'	0.476	0.022
20 – 'I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.'	0.475	0.022

Table 50. Significant Correlations and Levels of Significance between the Eleventh Question and Other Variables (Ordered by Level of Significance).

The twelfth question in the Final Survey questionnaire was about the usefulness of the forum exercises. Responses to this question vary from 'useless' (three students or 13.04%) to 'extremely useful' (one student or 4.35%), with responses 'useful' dominating (eight responses or 34.78%). Variability of the responses is larger than in the previous questions from this set (Figure 51). Similar to the eleventh question, this

question had two correlations. The highest correlation was with the response to the question about liking the forums (Table 51).

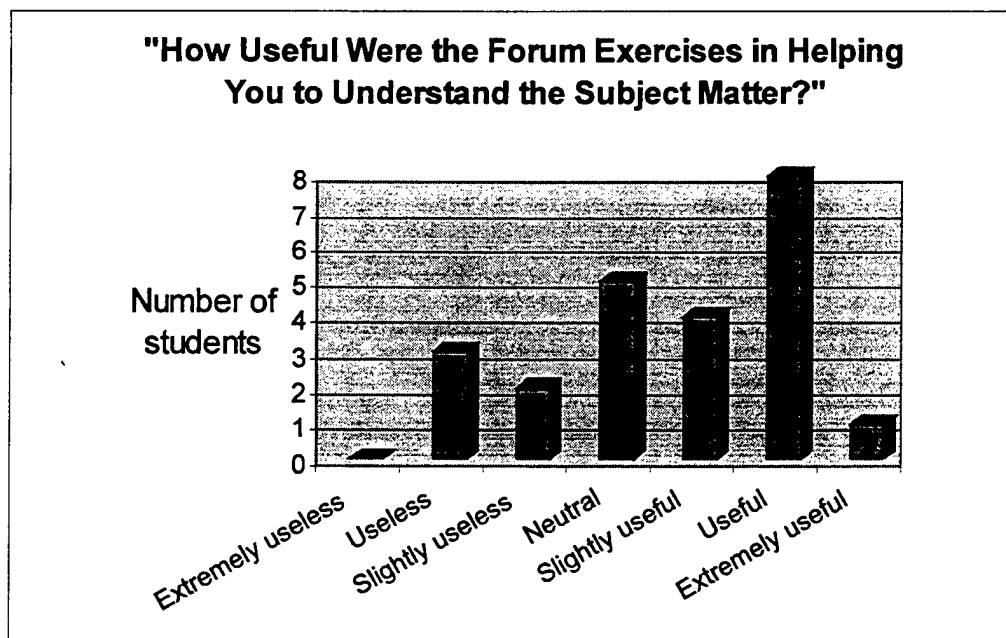


Figure 51. Distribution of the Responses to the Twelfth Question.

N = 23 Mean = 4.65 Median = 5
 Minimum = 2 Max = 7 Mode = 6

Statement / Variable	ρ	p value
14 – 'How did you like the Forum assignments?'	0.620	0.002
4 – 'Was the final exam useful in helping you to synthesize the concepts learned in the course?'	0.422	0.045

Table 51. Significant Correlations and Levels of Significance between the Twelfth Question and Other Variables (Ordered by Level of Significance).

The instructor recommended the next interesting question to determine if the quizzes in the course served the purpose she had intended: as feedback to the students. Figure 52 shows the distribution of the responses. Most of the students (seventeen or 73.91%) saw the quizzes as more or less useful as feedback, but four (17.39%) had the opposite opinion. Two (8.70%) chose neutral responses. Five correlations were significant, but none above 0.50. It is difficult to understand why this variable correlates

with variables dealing with module readings, interactivity between the students, and the flexibility that helped in succeeding in other classes (Table 52).

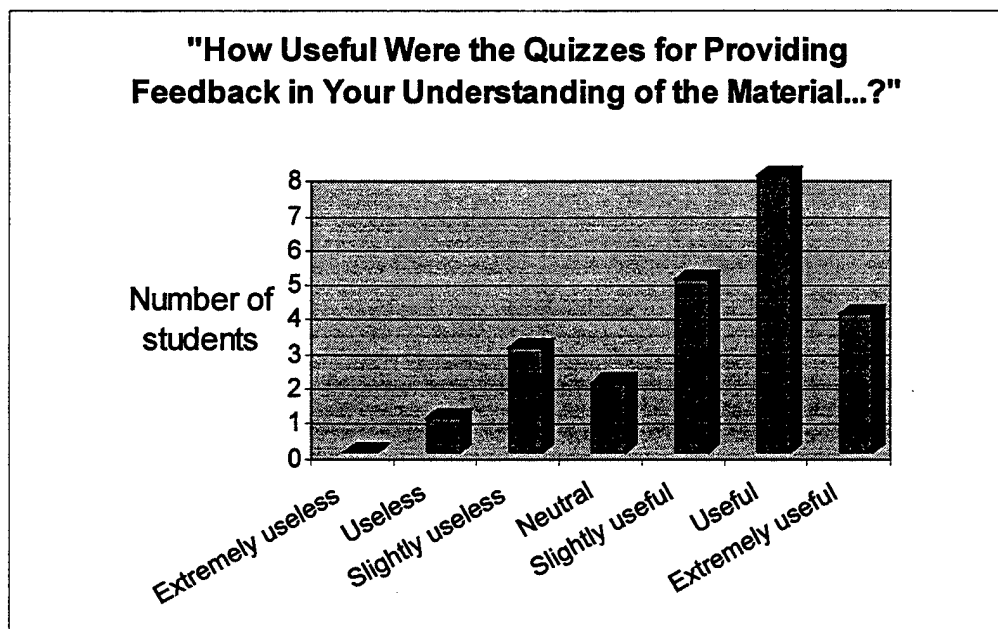


Figure 52. Distribution of the Responses to the Thirteenth Question.

N = 23	Mean = 4.78	Median = 6
Minimum = 2	Max = 7	Mode = 6

Statement / Variable	ρ	p value
8 – ‘How useful were guidelines provided at the course homepage for posting substantive responses to the Forums?’	0.500	0.015
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.492	0.017
27 – ‘Compare the quality of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.492	0.017
16 – ‘How did you like the Module readings?’	0.463	0.026
17 – ‘How did you like the website links that were provided?’	0.442	0.035

Table 52. Significant Correlations and Levels of Significance between the Thirteenth Question and Other Variables (Ordered by Level of Significance).

The next question asked the students how they liked forum assignments (Figure 53). Most of them ‘slightly liked’ (eight students or 34.78%) and ‘liked’ (six students

26.09%) them, but four students (17.39%) gave negative responses. Five (21.74%) gave neutral responses. Only two correlations were significant: one with responses to the question about the usefulness of forum exercises which is a very logical relationship, and another, about the amount of interactivity between the students and the instructor. The students, who saw the forums as useful, liked them. Those who thought that the course provided a satisfactory amount of interaction compared to face-to-face classes with the instructor tended to like forum assignments more than the students unsatisfied with the amount of interaction (Table 53).

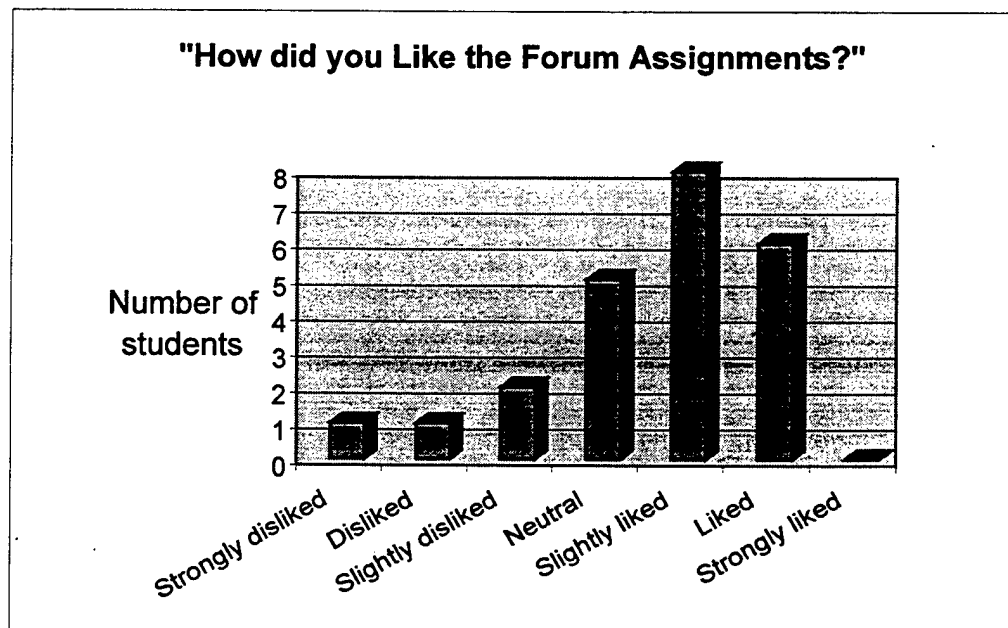


Figure 53. Distribution of the Responses to the Fourteenth Question.

N = 23

Mean = 4.56

Median = 5

Minimum = 1

Max = 6

Mode = 5

Statement / Variable	ρ	p value
12 – ‘How useful were the Forum exercises in helping you to understand the subject matter?’	0.620	0.002
24 – ‘Compare the amount of interaction you had with the instructor for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.487	0.018

Table 53. Significant Correlations and Levels of Significance between the Fourteenth Question and Other Variables (Ordered by Level of Significance).

Figure 54 shows the distribution of student responses about liking the textbook assignments. Most of them (eleven students or 47.83%) only ‘slightly liked’ them, a substantial number (seven students or 30.43%) ‘liked’ them, but two students (8.70%) disliked them, while three (13.04%) were neutral. Table 54 shows three significant correlations this variable had with responses to the question about the usefulness of the textbook, usefulness of the final exam, and about students’ feeling about how well this this course flexibility helped them for success in other courses. The last two correlations are not easy to explain, while the first relationship is very understandable.

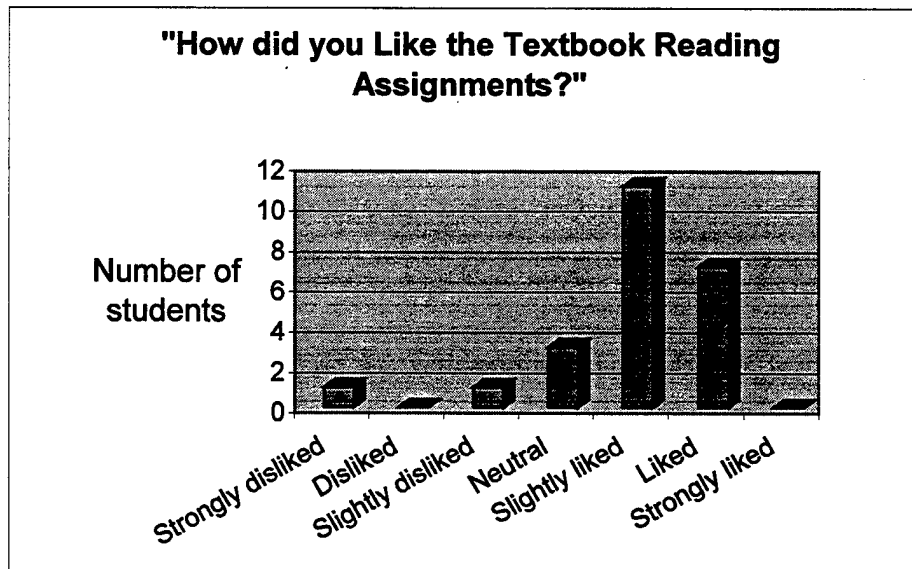


Figure 54. Distribution of the Responses to the Fifteenth Question.

N = 23 Mean = 4.91 Median = 5
 Minimum = 1 Max = 6 Mode = 5

Statement / Variable	ρ	p value
9 – ‘How useful was the textbook in helping you understand the course concepts, objectives and principles?’	0.636	0.001
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.428	0.042
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.425	0.043

Table 54. Significant Correlations and Levels of Significance between the Fifteenth Question and Other Variables (Ordered by Level of Significance).

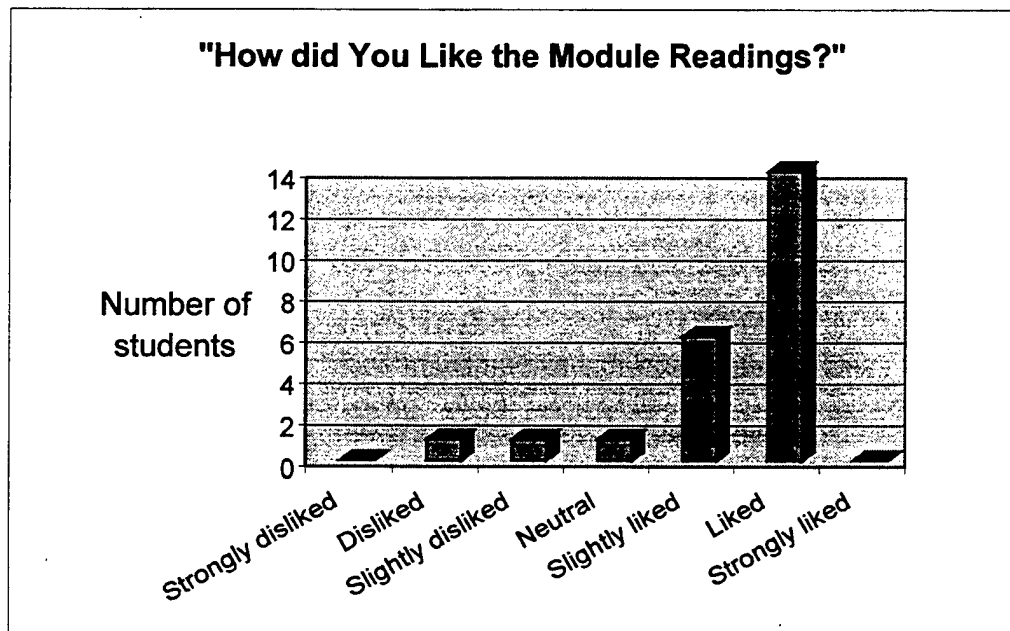


Figure 55. Distribution of the Responses to the Sixteenth Question.

N = 23 Mean = 5.34 Median = 6
 Minimum = 2 Max = 6 Mode = 6

The next question asked the students how much they liked the module readings. Over 60% of the students chose response ‘liked’, and almost all others ‘slightly liked’ the readings(Figure 55). Ten correlations were significant, starting with questions on liking

website links, beneficial flexibility of the course, and usefulness of the module readings (Table 55). Other questions included issues like amount of interactivity with other students, quizzes, and final exams.

Statement / Variable	ρ	p value
17 – ‘How did you like the website links that were provided?’	0.632	0.001
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.590	0.003
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.541	0.008
26 – ‘Compare the amount of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.539	0.008
8 – ‘How useful were guidelines provided at the course homepage for posting substantive responses to the Forums?’	0.516	0.012
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.480	0.020
13 – ‘How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules?’	0.463	0.026
25 – ‘Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar ‘face-to-face’ class.’	0.439	0.036
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.436	0.038
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.434	0.039

Table 55. Significant Correlations and Levels of Significance between the Sixteenth Question and Other Variables (Ordered by Level of Significance).

The question about liking website links provided in the course produced very favorably distributed responses (Figure 56). The response ‘strongly liked’ dominated (twelve students or 52.17%) and the response ‘liked’ followed (eight students or 34.78%). There were no negative reactions, and only one neutral response. Table 56 shows nine significant correlations. Responses to questions about the amount of

interaction between the students, about liking the module readings, usefulness of module readings, class flexibility, etc, are among significantly correlating variables.

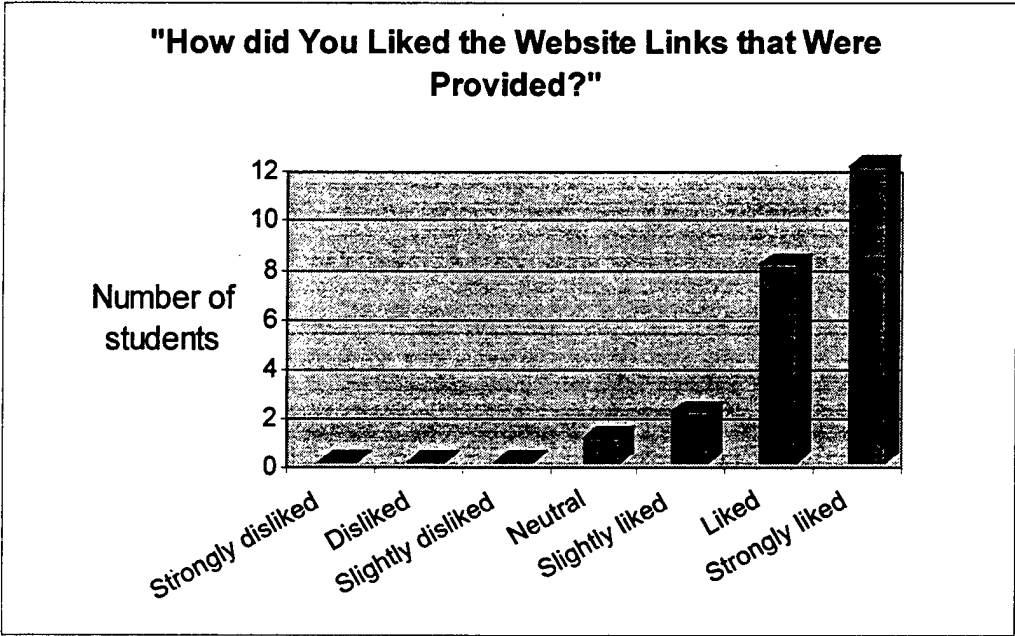


Figure 56. Distribution of the Responses to the Seventeenth Question.

N = 23	Mean = 6.35	Median = 7
Minimum = 4	Max = 7	Mode = 7

Statement / Variable	ρ	p value
26 – ‘Compare the amount of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.633	0.001
16 – ‘How did you like the Module readings?’	0.632	0.001
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.629	0.001
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.614	0.001
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.563	0.005
11 – ‘How useful were the linked websites in helping you to understand the course concepts, objectives and principles?’	0.557	0.006
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.528	0.010
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.453	0.030
13 – ‘How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules?’	0.442	0.035

Table 56. Significant Correlations and Levels of Significance between the Seventeenth Question and Other Variables (Ordered by Level of Significance).

The eighteenth question was one of five open-ended questions in this instrument.

It asked: ‘What other instructional materials, if any, should be included in the course?’

Five students did not respond. The responses of the others follow:

‘None’ – four opinions

- Can't think of any
- N/a for an online course: two responses
- Nothing that I can see at this time
- The materials that were provided were adequate

Suggestions

- A classroom
- Better textbook. Classroom discussion.

- I think the instructor somehow needs to play a bigger role. The students are not the subject matter experts so it got a little old listening to their comments. I would prefer to hear from the subject matter expert.
- More articles, etc. That's where I got a better feel for the topics.
- Perhaps more 'expert' participation in the forums. The information provided by LCDR Z. was very useful.
- References to periodicals that the library is on distribution for
- Search capabilities for forums
- The Army Handbook should be available either in hardcopy or on CD-ROM

Other notes

- I thought the textbook was very good, but expensive

The next open-ended statement asked: 'Describe your reaction to the instructional strategies used to teach the subject matter (textbook readings, Forums, websites)'. Four students did not respond. The responses were as follows:

Positive reactions

- Excellent
- Good
- I approve and have no comments on these strategies
- I liked it very much. See questions 18 and 21.
- Learning conceptual ideas were well suited for this particular online course
- No real difficulties
- The modular readings were great. Short and to the point. You need more tests to force one to at least get some understanding out of it. Fewer forums.
- The module readings and websites links greatly simplified the complex concepts provided in the text
- They were all sufficient
- They were fine. I can't think of a better way to do it...

- Too much flexibility

Neutral remarks

- Requires self-motivation
- I didn't read much of the forum discussions due to a lack of time and priorities
- Thought they were good, but honestly don't know how much good the quizzes did - i.e. someone could skip the readings and just look up the answers. It's really up to the students to do the reading if he wants to learn - and this is grad school, so maybe that's the way it should be?
- Same as question 18. (The response to question 18 was 'None'.)

Negative reactions and critiques

- Flexibility was not built into this course. Modules were not completely written prior to the course beginning and they were not available until the instructor opened them. That reduces the opportunity to work ahead.
- In a remote environment it would be great. However, at a university it does not work for me.
- Textbook - too technical. Websites - better than textbook. Best part of course forums - dull.
- Textbook was terrible. The forums might have been useful, but after awhile it seemed as if we kept talking about the same things.

The twentieth question asked: ' I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.' As Figure 57 shows, most of the student 'slightly agreed' (ten students or 45.45%) or 'agreed' (eight students or 36.36%) with this statement. Only two (9.09%) 'slightly disagreed'. Table 57 shows five correlations, which were significant with two other statements addressing student abilities to articulate certain subject area issues, ability to access appropriate resources, ability to participate in open discussions, and the

usefulness of linked websites to help a student understand the course concepts, objectives, and principles.

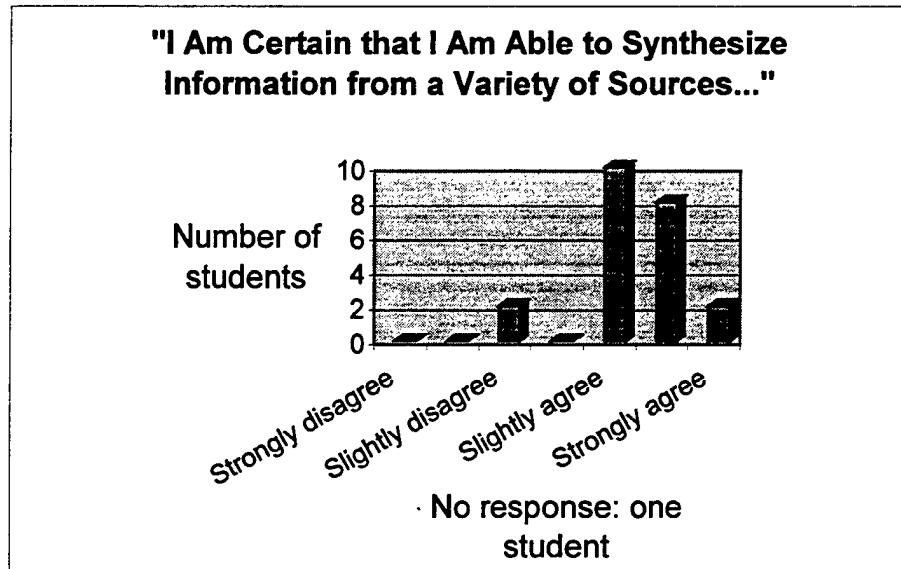


Figure 57. Distribution of the Responses to the nineteenth Question.

N = 22 Mean = 5.36 Median = 5
 Minimum = 3 Max = 7 Mode = 5

Statement / Variable	ρ	p value
2 – ‘As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings?’	0.634	0.002
3 – ‘Do you feel that you are able to articulate how commercial space systems will impact military operations?’	0.605	0.002
5 – ‘I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.’	0.509	0.013
6 – ‘I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.’	0.478	0.021
11 – ‘How useful were the linked websites in helping you to understand the course concepts, objectives and principles?’	0.475	0.022

Table 57. Significant Correlations and Levels of Significance between the Twentieth Question and Other Variables (Ordered by Level of Significance).

The twenty-first question was also open-ended: "As a result of this on-line course experience, do you feel that you have changed your fundamental approach to learning? Please respond 'yes', 'somewhat' or 'no', and explain your answer." Clearly, most of the students disagreed they changed their fundamental approach to learning. Below are the systematized student responses:

Yes

- Yes, I have learned that there is a great deal of information available through many sources and media. The Internet, texts, periodicals, and instructor's modules all contributed to a great learning experience.
- Yes, I plan on researching distant learning for a possible thesis subject
- Yes, only because I am aware of many of the opportunities provided by the NETG program and would feel more comfortable going through some of those online courses.

Somewhat

- Somewhat no. Still miss the students' interaction.
- Somewhat
- Somewhat. I still think that you can't fully replace the added value with an instructor in a classroom environment. However, I feel that adequate and interesting learning can take place on-line.
- Somewhat. Think on-line is a good venue for certain types of courses/curricula. The Space Tech course for ITM is such a combination.

No

- No, because I feel that I was already receptive to the distance learning concept of education having just completed another 18 months long masters program with a different university.
- No, I need the classroom setting
- No, I still like to take notes, and have verbal discussion in a short period of time, instead of taking an hour(s) explaining/writing a message to post to the forum.
- No, I'm hard headed

- No. (Three responses.)
- No. I did what I had to do to fulfill the requirements of the course. Where I was more interested, I put more effort into exploring the topic areas. This is how I approach learning in any situation. I don't feel like that has changed because of this course.
- No. I have always searched for additional resources to expand on presented material. I like to form unbiased and objective opinions on subjective matter. Also, I like to see different explanations on scientific matters to ensure understanding. This course reinforced that approach.
- No. I shall prefer classroom environment with one-to-one approach.
- No. I still feel I would get more out of in class instruction. Perhaps that is just a personal preference. The basic concept here is that you should teach yourself via the online class, which is probably ok for something like a basic space class. But I would rather have a professor teach me face-to-face, allowing for in-class discussion, and focus of concepts and efforts.
- No. I think this method lends itself to training type courses, not education.
- No. I thought going in that this would be difficult because I tend to get the most out of class discussions vice reading, but wanted to give a try. I am now more confident than ever that DL is not for me.
- No... My ways of learning are pretty well set.
- No... Read and absorb is still primary...
- Not yet - I did not put my best forward this quarter, in this class.

In question 23 of A-2 questionnaire, with question 23 ('So far, what do you like about this on-line course?'), most students responded they liked the time management flexibility of the course. The next two questions in the Final survey readdressed that issue: one in the context of student success within the course and the another in the sense of student success in other classes/courses. Figure 58 shows the distribution of the responses to the first question ('Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?'). The majority of the students 'strongly agreed' (eight students or 34.78%) or 'agreed' (seven students or 30.43%), but six of them (26.09%) disagreed. Table 58 shows the significant correlations. There were seven

of them: liking the module readings, quality of interaction with the instructor, liking the website links, and with three questions dealing with self-perceived abilities or confidence.

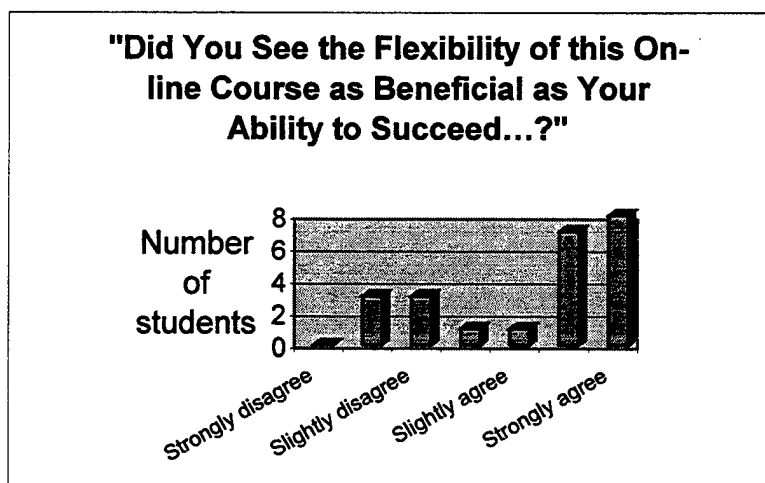


Figure 58. Distribution of the Responses to the Twenty-Second Question.

N = 23

Mean = 5.30

Median = 6

Minimum = 2

Max = 7

Mode = 7

Statement / Variable	ρ	p value
16 – 'How did you like the Module readings?'	0.590	0.003
1 – '...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?'	0.585	0.003
6 – 'I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings.'	0.555	0.006
25 – 'Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar 'face-to-face' class.'	0.533	0.009
17 – 'How did you like the website links that were provided?'	0.528	0.010
10 – 'How useful were the on-line Module readings in helping you to understand the course concept...'	0.512	0.012
5 – 'I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.'	0.482	0.020

Table 58. Significant Correlations and Levels of Significance between the Twenty-Second Question and Other Variables (Ordered by Level of Significance).

The second question about flexibility had a different distribution of the responses than the first one (Figure 59): asked if the flexibility helped them succeed in other classes, all students agreed with the statement. Ten of them chose 'agree' and ten 'strongly agree' (43.48% each). Table 59 shows the correlations with other variables. Seven were significant. Only two variables appeared significantly correlated with responses to both questions about the helpfulness of the flexibility of the course: liking website links and liking module readings.

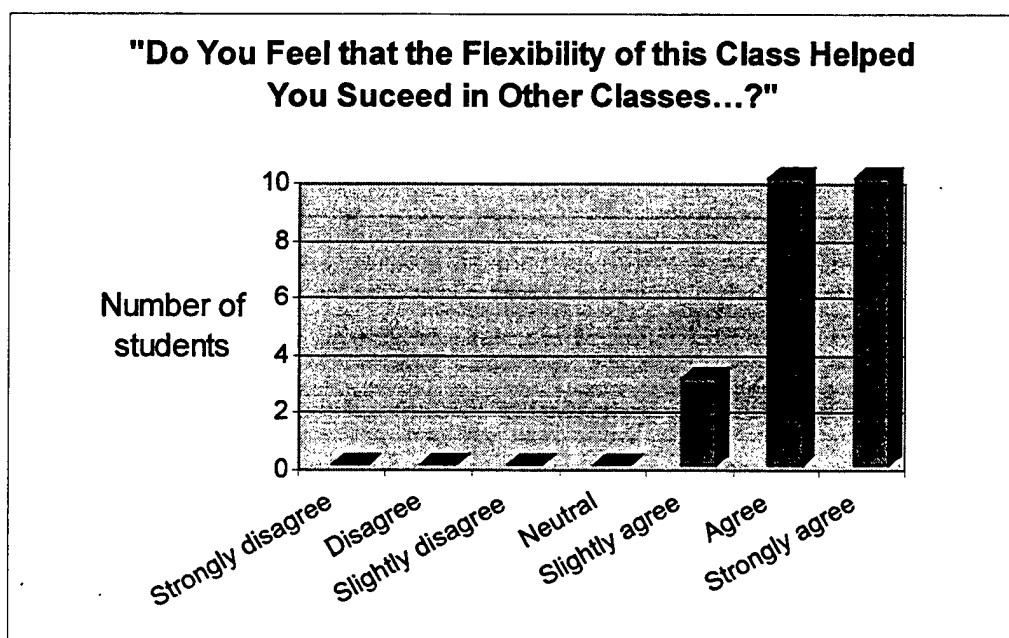


Figure 59. Distribution of the Responses to the Twenty-Third Question.

N = 23	Mean = 6.21	Median = 6
Minimum = 5	Max = 7	Mode = 7

Statement / Variable	ρ	p value
17 – ‘How did you like the website links that were provided?’	0.563	0.005
10 – ‘How useful were the on-line Module readings in helping you to understand the course concept...’	0.536	0.008
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.503	0.014
26 – ‘Compare the amount of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.500	0.015
13 – ‘How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules?’	0.492	0.017
16 – ‘How did you like the Module readings?’	0.480	0.020
15 – ‘How did you like the textbook reading assignments?’	0.425	0.043

Table 59. Significant Correlations and Levels of Significance between the Twenty-Third Question and Other Variables (Ordered by Level of Significance).

The twenty-fourth item was the first of four dealing with issues of interactivity in the course. The first question asked students to: “Compare the amount of interaction you had with the instructor for this on-line course as compared with a similar resident ‘face-to-face’ course. Note that this question is about ‘amount’ while another question will cover ‘quality of interaction’. Try to consider only the amount of interaction that occurred on-line (including e-mails) as opposed to what occurred if/when you stopped by the instructor's office.”

Figure 60 shows the distribution of the responses: most of the students felt there were less interaction between the students and the instructor: ten out of twenty-two (43.48%) responded ‘significantly less’; five (21.74%) responded ‘less’; and two (8.70%) responded ‘slightly less’. Four responses (17.39%) were in the middle of the scale (‘about the same’) and two on the opposite end (one [4.35%] responded ‘slightly more’, and one [4.35%] responded ‘more’). This variable had significant correlations with only three

other variables (Table 60). All three of them actually had some kind of interaction between the students and the instructor: quality of interaction between the students and the instructor; liking forum assignments (in forums the instructor also interacted with the students); and students view on usefulness of the final exam.

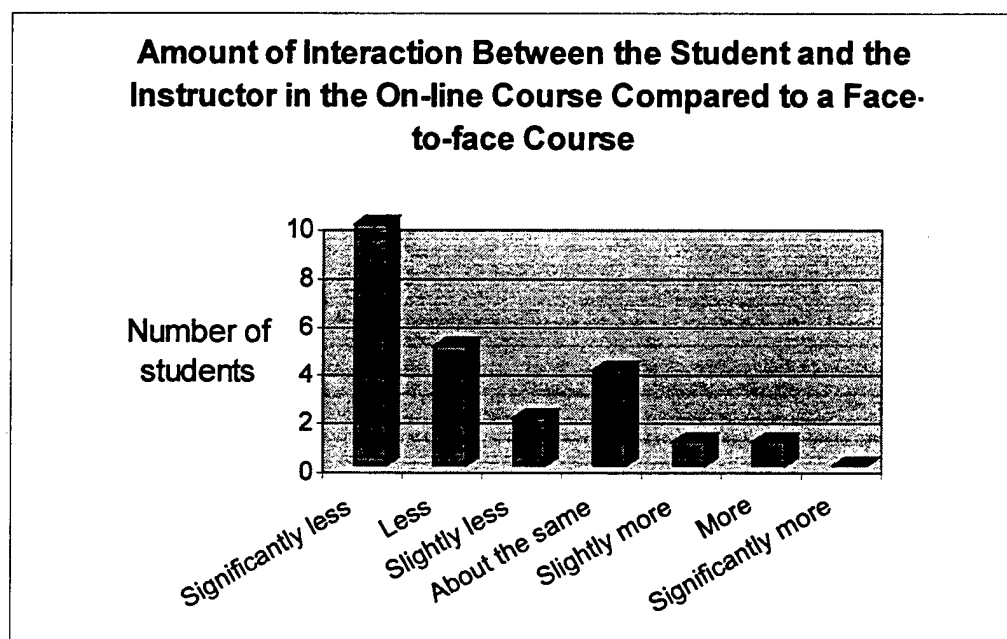


Figure 60. Distribution of the Responses to the Twenty-Fourth Statement.

N = 23

Mean = 2.30

Median = 2

Minimum = 1

Max = 6

Mode = 1

Statement / Variable	ρ	p value
25 – ‘Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar ‘face-to-face’ class.’	0.666	0.001
14 – ‘How did you like the Forum assignments?’	0.487	0.018
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.456	0.029

Table 60. Significant Correlations and Levels of Significance between the Twenty-Fourth Question and Other Variables (Ordered by Level of Significance).

The next statement about interactivity was the following: "Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar "face-to-face" class."

Figure 61 shows the distribution of the student responses. This distribution is different from the distribution of student responses to the question about the amount of interaction. In this distribution there were six (26.09%) 'significantly less' responses and eleven (47.83%) 'about the same' responses, while in previous question there were eleven (47.83%) 'significantly less' responses and four (17.39%) 'about the same' responses.

Table 61 shows significant correlations.

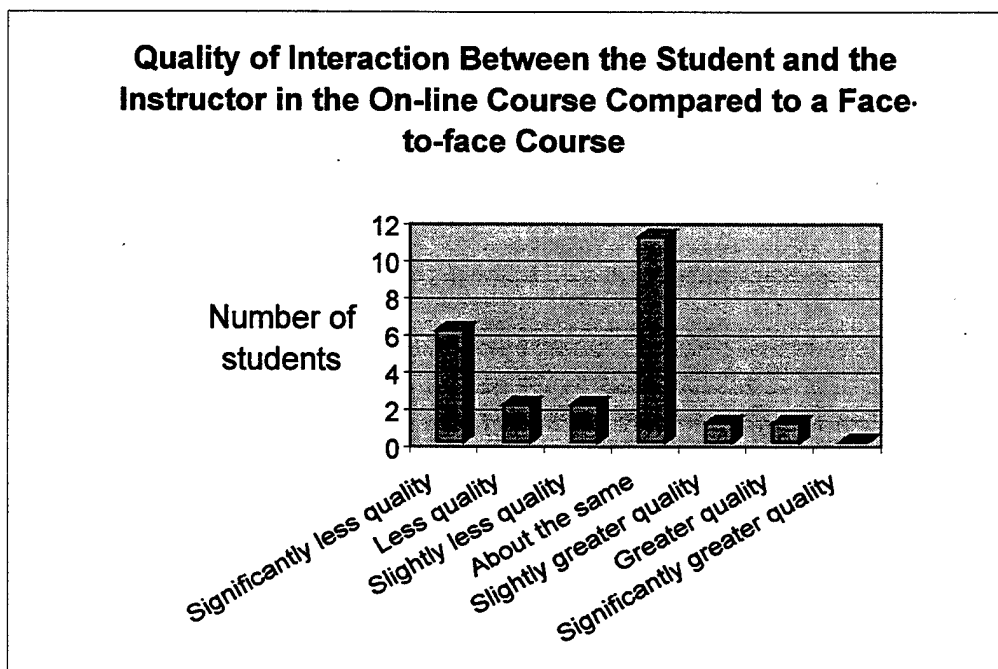


Figure 61. Distribution of the Responses to the Twenty-Fifth Statement.
 N = 23 Mean = 3.09 Median = 4
 Minimum = 1 Max = 6 Mode = 4

Statement / Variable	ρ	p value
24 – ‘Compare the amount of interaction you had with the instructor for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.666	0.001
22 – ‘Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?’	0.533	0.009
4 – ‘Was the final exam useful in helping you to synthesize the concepts learned in the course?’	0.523	0.011
16 – ‘How did you like the Module readings?’	0.439	0.036

Table 61. Significant Correlations and Levels of Significance between the Twenty-Fifth Question and Other Variables (Ordered by Level of Significance).

The twenty-sixth statement, which was the third statement on interactivity, was: “Compare the amount of interaction you had with other students for this on-line course with a similar resident ‘face-to-face’ course. Note that this question is about ‘amount’ while another question will cover ‘quality of interaction’.”

Figure 62 shows the distribution of responses. The responses seemed to group around two areas: firstly around ‘significantly less’ and ‘less’ (their total is twelve students or 52.17%), and secondly around ‘about the same’ and ‘slightly more’ (nine students or 39.13%). Although almost all the responses were present (six of seven possible) and student responses were split into two groups with opposite opinions, students predominantly thought that amount of the interaction in the course was lower than in a face-to-face course. Students significantly differ by perception of the interaction when comparing DL to face-to-face course, what is probably significant factor of their reactions about the course. However, this finding does not tell us anything about the cause of such split in opinions.

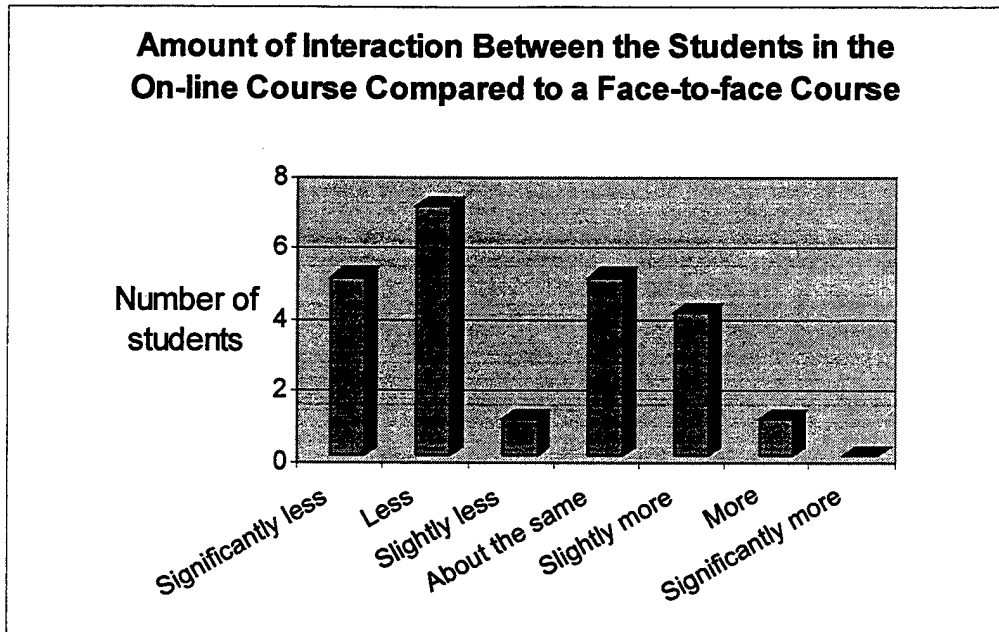


Figure 62. Distribution of the Responses to the Twenty-Sixth Statement.

N = 23

Mean = 2.96

Median = 2

Minimum = 1

Max = 6

Mode = 2

This variable had six statistically significant correlations (Table 62), with the following variables: liking website links, liking module readings, opinion about the help the flexibility of this course provide to succeed in other classes, quality of the interaction between students, and others.

Statement / Variable	ρ	p value
17 – ‘How did you like the website links that were provided?’	0.633	0.001
16 – ‘How did you like the Module readings?’	0.539	0.008
27 – ‘Compare the quality of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.511	0.013
23 – ‘Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter?’	0.500	0.015
1 – ‘...Do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?’	0.429	0.041

Table 62. Significant Correlations and Levels of Significance between the Twenty-Sixth Question and Other Variables (Ordered by Level of Significance).

The next question asked: 'Compare the quality of interaction you had with other students for this on-line course as compared with a similar resident 'ace-to-face' course.'

The students gave approximately the same number of responses to each category from 'significantly less' (five or 21.75%) to 'about the same' (also five), what makes total of eighteen students (78.26%). Fewer students (21.74%) thought the quality was better in the on-line class (three students [13.04%]) responded 'slightly greater quality', one (4.35%) responded 'greater', and one 'significantly greater'). Figure 63 shows the distribution. Only two correlations were significant: with the amount of that same interaction between the students, and with their opinions on the usefulness of the quizzes (Table 63).

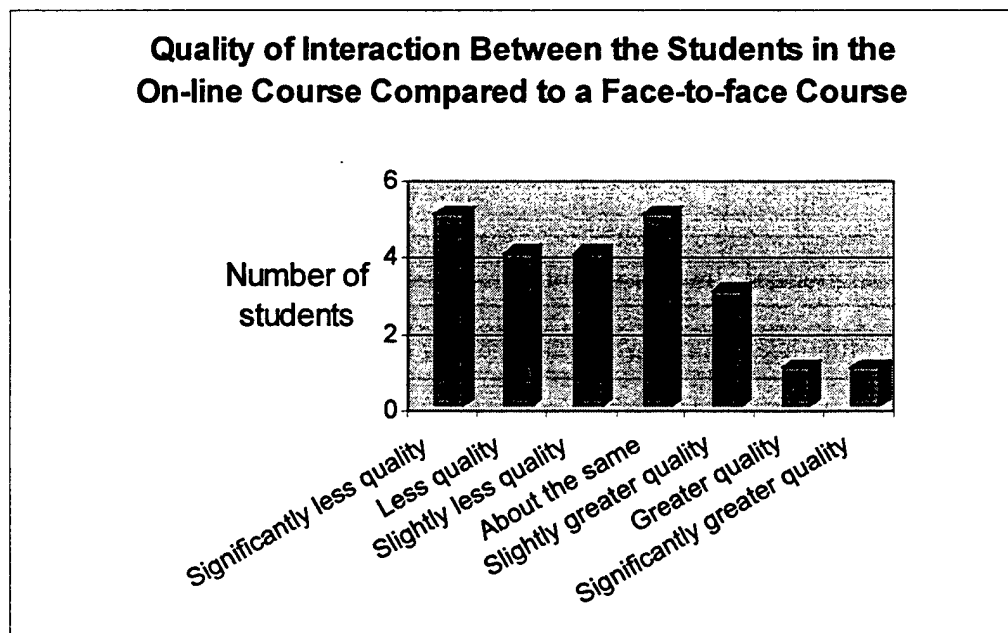


Figure 63. Distribution of the Responses to the Twenty-Seventh Statement.

N = 23

Mean = 3.17

Median = 2

Minimum = 1

Max = 6

Mode = 2

Statement / Variable	ρ	p value
26 – ‘Compare the amount of interaction you had with other students for this on-line course as compared with a similar resident ‘face-to-face’ course.’	0.511	0.013
13 – ‘How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules?’	0.492	0.017

Table 63. Significant Correlations and Levels of Significance between the Twenty-Seventh Question and Other Variables (Ordered by Level of Significance).

The twenty-eighth question was open-ended. It asked the following: ‘Describe your reaction to the media used to present the instruction (i.e. online delivery instructional technologies.)’ Three students did not give any response. Below are the student responses:

Positive reactions

- I felt the media used to present the instruction was quite appropriate. The mix of web links and instructor input in the form of the module readings made synthesis of the text material much easier and more thorough.
- I liked them uh-lot
- Favorable reaction
- Good when it worked
- I thought it was fine
- Interesting
- It was great when it was working. I am not sure I understand this question
- It was OK when it worked
- It works for me!
- Over all I like it
- Really enjoyed the links and instructor presentations for modules
- The media was good when it was up
- The media was good, with the notable exception of having to pick up hardcopies of documents from the instructor. This defeated the purpose of online instruction; I should get everything from the computer.

Neutral reactions or suggestions

- I prefer classroom
- Need a search engine. Plus better navigational tools
- No reaction... Just reality
- None.
- Thought the media was adequate for the general concepts of the course. I thought that if the course were to get more technical, a different media would be required

Negative or skeptical reactions

- The technology was not helpful. Caused several delays in the course and was not always user friendly.
- Too much flexibility

The last open-ended question simply gave students opportunity to add other comments. Fifteen of them did not have any additional comments. Those who decided to comment responded as follows:

Positive comments

- CDR Higgins' positive energy was a real plus!
- Great course to teach on-line. The danger here is that because one course type works well on-line, we start trying to do other courses on-line that just don't lend themselves well to the venue, like heavy-math type courses, EO courses, etc.
- In this environment I would prefer a classroom environment

Neutral comments or suggestions

- Need feedback on forum
- The forum should be real-time. Schedule multiple meeting times within the groups to have online chats. Then post discussion for bulletin board responses from others.
- I do not offer any improvements, I believe a student will get as much out of the course as they put into it. The fact that this was a distance learning

format did not have a negative impact on my view of the course. CDR Higgins always kept students informed and maintained a motivation level that is required with an on-line course. I will certainly recommend SS3011 and CDR Higgins to other students. Thanks for all the great instruction!

- Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class? Yes - when all the technical problems are sorted out. However, due to this being for first time the amount of technical problems removed this flexibility as site was often down when it would have been convenient to work on the modules/get the assignment. As a result, there were several occasions when we had to cram to complete the assignments when it was not a convenient time to work on it because the site was down when it would have been convenient.
- It's a good course, but not for me this quarter

The last two categorical but non-ordered variables in the instrument represented the on-line version of the Long-Dziuban Reactive Behavior Protocol: a set of four boxes with responses was used to measure personal on-line behavior types, and another set of four boxes with responses was used to measure personal traits. In the first case, the students were able to choose only one box, and in the latter case they could choose from none to four traits. Figure 64 shows distribution of the responses on the self-reported types. In our sample, the Passive Independent type dominated; there were no responses for the Passive Dependent type.

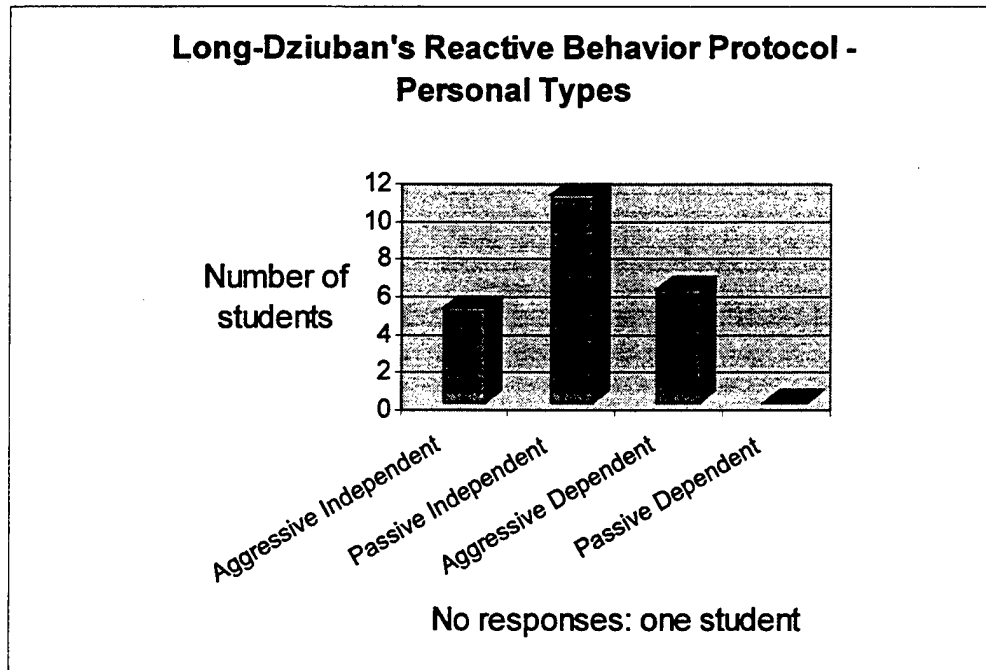


Figure 64. Distribution of the Responses to Long-Dziuban's Reactive Behavior Protocol – Personal Types.

This distribution is surprising. Dziuban, Moskal, and Dziuban (1999) found only 12% of University of Central Florida (UCF) students attending on-line courses (N=381) to belong to Passive Independent (PI) type, while in this study eleven students or 50% belonged to the PI type. Passive Dependent (PD) was the least frequent type in both cases: 5% in Dziuban's study and none in this thesis research. Aggressive Dependent (AD), most frequent in Dziuban's study (60%), was second most frequent in our sample (six students or 27.27%), while 23% of students belonged to Aggressive Independent type in Dziuban's study, similar to this study (five students or 22.73%).

The sample in this case study is small, and the students were not university students as these in Dziuban's study but military officers selected and self-selected for graduate level education in NPS. There is not enough data to conclude whether this difference is caused by different (highly competitive) environments, of differences

between the two populations, of process of selection of NPS students, or of other factors. If Long's types are interpreted as stabile personality types, the difference would probably be the result of the selection and self-selection of students, but because Long and other authors indicated that there are possibilities of influence to typical reactive behavior patterns (for instance, by counseling them), such a hypothesis is not valid.

Figures 65 and 66 show responses to the second part of the Protocol, with the combined responses shown separated in the first graph, and included in the basic traits in the second one. Clearly, compulsive trait, alone (eight students or 42.11%) or combined with impulsive trait (five students or 26.32%), dominated. Again, interpretation is difficult; it is very hard to distinguish personal preferences, environmental impacts, and other possible factors that resulted with this distribution.

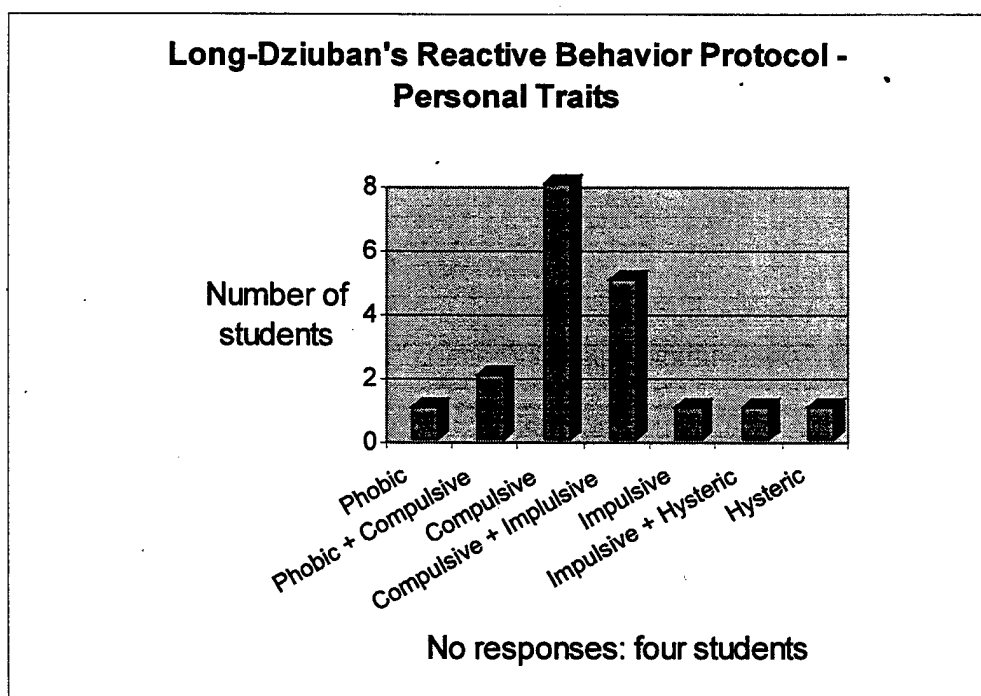


Figure 65. Distribution of the Responses to Long-Dziuban's Reactive Behavior Protocol – Personal Traits, with Separated Combinations.¹³

¹³ According to the authors of the instrument, in this scale a subject can choose any combination of

It was difficult to find the appropriate statistical method to check the level of association or correlation of responses to this Protocol with other variables in the instruments. I decided to assign 1 to the responses a student chose, and 0 to not-chosen responses, and I calculated correlations with other variables, using only coefficients of rank correlation because of a very small number of observations. Table 64 shows all the statistically significant correlations. Also, in these calculations I used responses to the second part of the Protocol or personal traits with combinations included in basic four traits. There were only three significant correlations. First correlation shows that PI type was associated with impulsive trait in this sample. Other correlations are very hard to interpret.

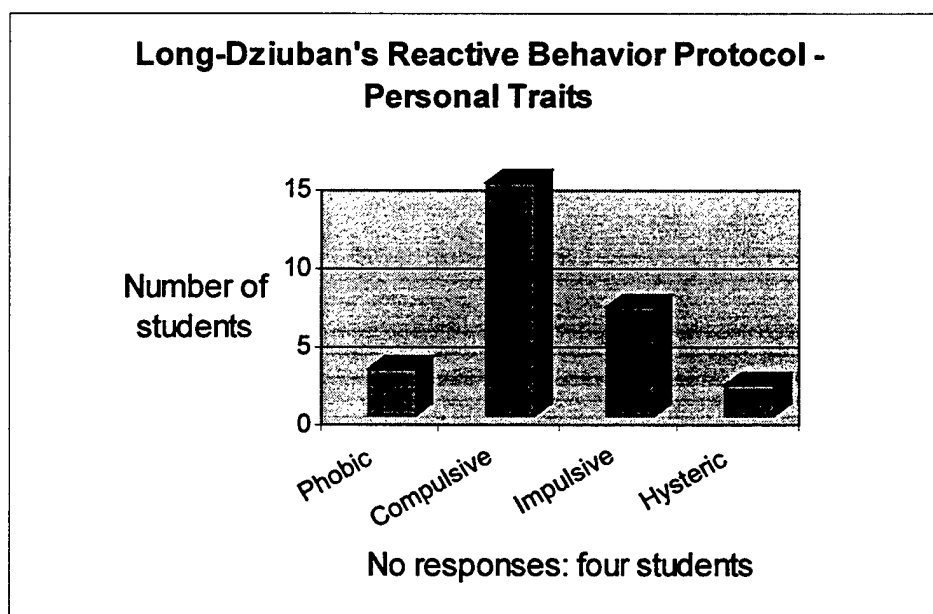


Figure 66. Distribution of the responses to Long-Dziuban's Reactive Behavior Protocol – Personal Traits, with Combinations Included into Basic Traits.

responses, from none to all four. In this case students chose from none to two traits – which I call 'combinations'.

Variables	ρ	p value
'Passive Independent type' and 'Impulsive trait'	0.691	< 0.001
'Aggressive Dependent type' and question number 10: 'How useful were the on-line Module readings in helping you to understand the course concepts, objectives and principles?'	0.471	0.023
None personal traits chosen and question number 24: 'Compare the amount of interaction you had with the instructor'	0.419	0.047

Table 64 Significant Correlations and Levels of Significance Between Long-Dziuban's Reactive Behavior Protocol Variables (Personal Traits Include Combinations in Basic Traits).

Final survey – Summary

The last on-line questionnaire was administered anonymously. Twenty-three of thirty students filled out the questionnaire. The questionnaire consisted of thirty-one items, including five open-ended questions or statements.

In terms of student views on their final status in achieving the course learning objectives, most students replied positively. Most of objectives, according to distributions of student responses, were met. Correlations with other variables were significant mostly within this same group of variables (asking about meeting different course objectives), but there were other significant correlations too.

The second group of questions addressed how useful the students viewed some of the course features: guidelines in the course homepage, guidelines for posting to the forums, the textbook, the module on-line readings, linked websites, the forum, exercises, and the quizzes as feedback to the students. Most distributions strongly tended to positive

responses, but there were significant numbers of negative responses to questions addressing usefulness of forums and quizzes.

The third set of questions asked students how much they liked some of the features like forum assignments, textbook reading assignments, the module readings, and website links. Responses on usefulness and on liking the same features (module readings, forum exercises/assignments) correlated, but coefficients were not high: liking and assessing utility of same feature is similar, but is definitely not the same.

Responses to the open-ended questions showed some trends. Asked what other instructional materials should be included in the course, five students responded 'none', but eight students gave one or more suggestions. Regarding the question about their reactions to the instructional strategies used in the course, eleven students responded positively, four neutrally, and four responded negatively or with critiques. Asked whether this course fundamentally changed their approach to learning, most students (sixteen) responded negatively, but three agreed, and four partially agreed. Their reactions about on-line delivery of instructional technologies were mostly positive (thirteen responses), some neutral (five), and only two negative. For additional comments, the students provided three positive points of view, and several neutral comments and suggestions.

The flexibility of the on-line course in the sense of time management, mostly seemed to be more beneficial to the students success in other classes/courses than in this course.

Asked about interactivity, most students thought that the amount of interactivity between the students and the instructor in the course was less than in a face-to-face course, but they were much more uncertain when asked about the quality of that

interaction. They were also not sure about the amount of interaction between the students and about the quality, but the majority thought that the quality was lower in an on-line course.

The student responses to Long-Dziuban's Reactive Behavior Protocol were very interesting, showing obvious differences from findings in other studies. Because of a small number of observations and some other methodological limitations, especially in terms of selectivity and self-selectivity that formed this group of students (military officers under pressure of competitiveness), an interpretation of these results is difficult.

B. STUDENT OPINION FORMS (SOFs)

Twenty-two students completed the Student Opinion Forms anonymously. The first part of the SOFs contains data on which curriculum the student attends, about the number of credit hours, and about the number of quarters already completed. As already stated, all of the students in the sample attended the same curriculum. Figure 67 shows the distribution of the numbers of hours per week the students had during the quarter.

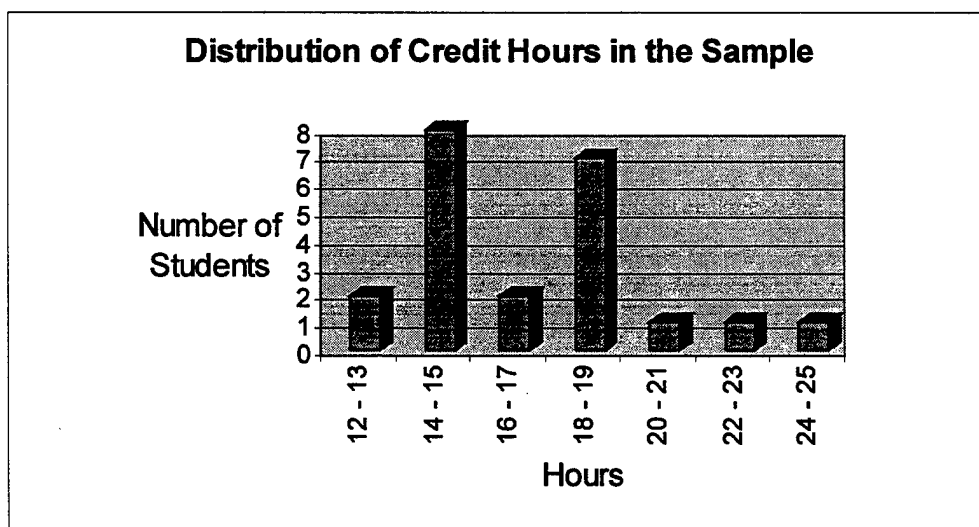


Figure 67. Weekly Number of Credit Hours Distribution in the Sample.

N = 22

Mean = 16.73

Minimum = 12

Maximum = 24

Standard deviation = 2.90

Most of the students in the sample had between 14 and credit 19 hours (17 of 22, or 77.27%), but the range between the minimum and maximum is relatively large – a 12 hour difference. The calculation of the rank correlations between the number of hours and any other variable in SOFs showed no significant relationships. In other words, credit hours did not make any difference in any of the other variables in the instrument.

The second variable was about the number of quarters a student already completed at NPS before the current quarter. Figure 68 shows the distribution of the responses with the basic statistical indicators.

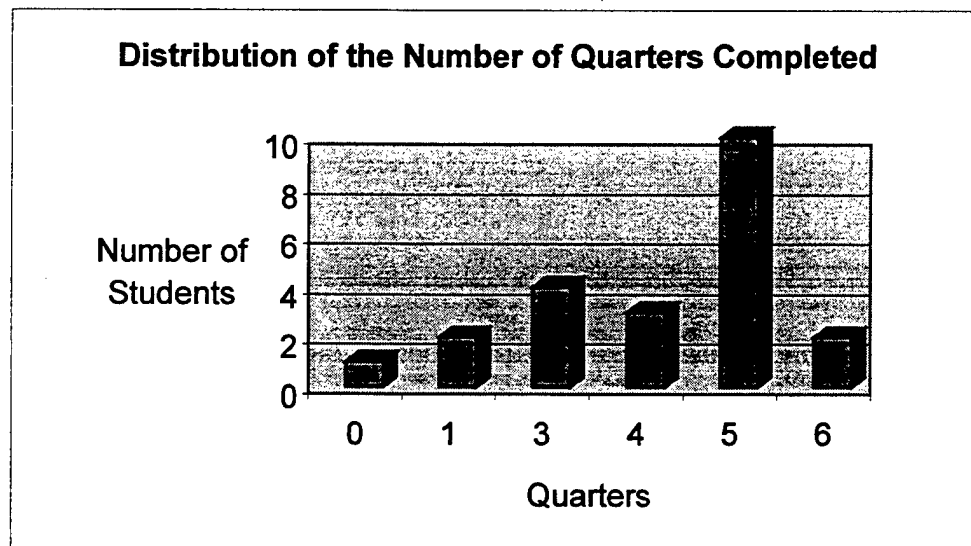


Figure 68. Distribution of the Number of Quarters Completed.

N = 22

Mean = 4.00

Minimum = 0

Maximum = 6

Standard deviation = 1.63

The relative majority of the students (10 of 22, or over 45%) were in their sixth quarter of their curriculum during the course, but there were individual students with

none to six quarters finished. Again, there were no significant rank correlations with any other variable.

Answering the next question, all of the students confirmed that the course was required in their curriculum and was not an elective.

After describing basic data, the sixteen statements asked the students for their opinions about the course and the instructor. In addition, SOFs provided students an opportunity to write their own comments. Responses to the sixteen statements are in the form of a five-point scale. For the first eleven statements, the scale had the following descriptions: 'strongly agree'; 'agree'; 'no strong opinion'; 'disagree'; 'strongly disagree'; and 'no comment'. The latter means the question is irrelevant for the course or the student does not want to respond to the question. In the last five statements, where students provided an overall rating of the instructor, the course, the textbook, the quality of the exams, and the laboratories, responses were: 'outstanding (among the top 10%)'; 'excellent (among the top 30%)'; 'about average (middle 40%)'; 'fair (in the lowest 30%)'; and 'poor (in the lowest 10%)'.

I did not include 'No comment' or 'Not applicable' responses in the graphs. These are only mentioned in parentheses because they do not represent an opinion but the unwillingness for subjective reasons to give an opinion about that statement. Data on median, maximum, minimum, or mode category of the responses to these question do **not** include 'No comment' or 'Not applicable' category responses. The same holds true for rank correlations. For this reason, the higher ρ value in come cases may be less significant because of the smaller number of observations (N) in the calculation.

Therefore I ordered the coefficients of rank correlation by significance. If the significance was equal, I ordered them by the size of the coefficient.

The sixteenth statement ('Overall, I would rate the laboratories') is not applicable for this course and is therefore disregarded.

The distribution of the responses to the first statement is shown in Figure 69.

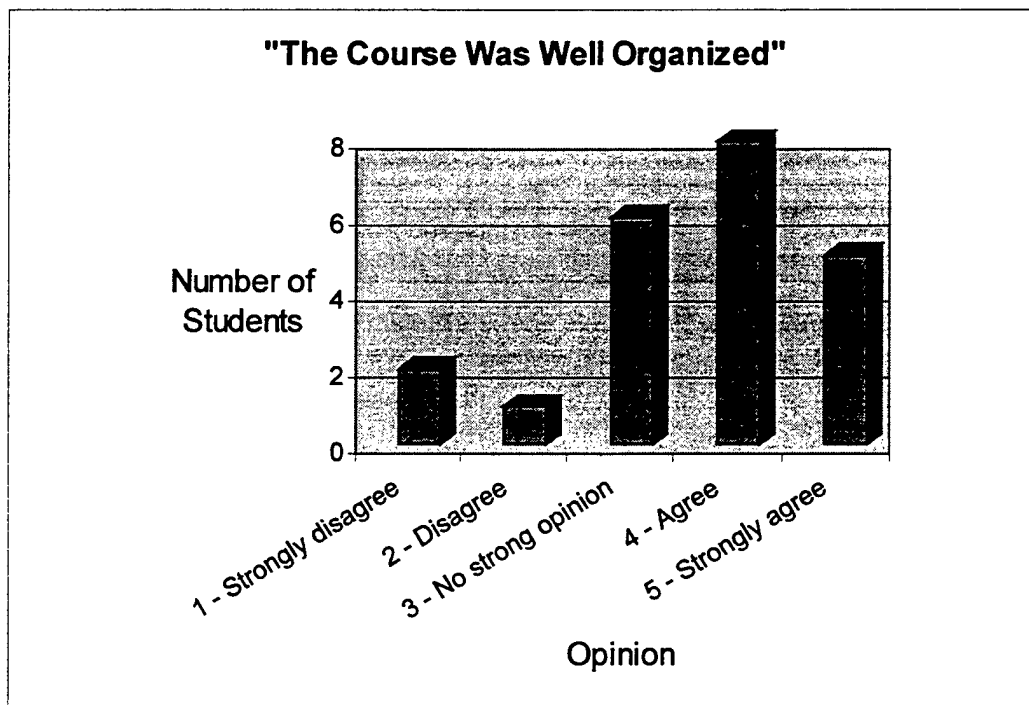


Figure 69. Responses to the First Statement in the SOFs.

N = 22	Mean = 3.59	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

From the distribution in Figure 69, student opinions on the organization of the course varied from very negative and moderately negative (three students or 13.64%) or neutral (six students or 27.27%), to positive responses, which is the majority (thirteen students or 59.09%). In general, most of student were at least neutral or, predominantly, positive about course organization.

The responses to the first statement ('The course was well organized') have significant correlations with twelve of the other fourteen variables (Table 65).

Statement number	Statement	ρ	p value
7	'The instructor was prepared for the course'	0.860 ¹⁴	< 0.001
9	'The instructor made this course a worthwhile learning experience'	0.762	< 0.001
14	'Overall, I would rate the textbook'	0.726	< 0.001
8	'The instructor's objectives for the course have been made clear'	0.724	< 0.001
5	'I had confidence in the instructor's knowledge of the subject'	0.703	< 0.001
15	'Overall, I would rate the quality of the exams'	0.702	< 0.001
12	'Overall, I would rate the instructor'	0.648	< 0.001
13	'Overall, I would rate this course'	0.671	0.001
11	'The instructor cared about student progress and did his share in helping us to learn'	0.654	0.001
10	'The instructor stimulated my interest in the subject area':	0.649	0.001
6	'I felt free to ask questions'	0.644	0.001
4	'Difficult concepts were made understandable'	0.598	0.003
2	'Time in class was spent effectively'	0.825 ¹⁵	0.006

Table 65. Correlations and Levels of Significance between Responses to the First and to the Other Statements (Ordered by Level of Significance).

Their responses to the first statement significantly correlated to the responses to almost all the other statements; statements that represent desirable qualities of the course, the instructor, or the textbook. The organization of the course is very important and is a 'related-to-everything' characteristic within the context of the course. One of the highest correlations in this instrument is between the first and the seventh statement. This

¹⁴ After elimination of 'No comment' or 'Not applicable' responses, number of pairs of responses (N) for calculation of this correlation was 18. N for any other variable in this set is 22 minus the number of 'No comment' responses, which is visible in the graph of distribution of responses to that variable.

¹⁵ For the same reason, N of data pairs taken into account was only nine.

correlation means that the students' view on organization of the course and on the quality of the instructor's preparation highly correlates.

It is interesting to see which question the first question was **not** significantly correlated with. This turned out to be the third question: 'The instructor seemed to know when students didn't understand the material'. This non-significance of the correlation probably appeared because of the changed nature of the feedback from the instructor to the students in the DL course. Feedback from the instructor to students in DL is mostly individual; therefore, very different than in a 'normal' course. Crucial difference in comparison with a face-to-face class is that media used for the instructor's feedback in DL course (e-mail and other similar means) excludes the instructors' personal presence. Therefore, it was more difficult for students to determine if the instructor was able to see student understanding of the material.

The third statement was 'The instructor seemed to know when students didn't understand the material' Figure 70 shows the following distribution of responses.

As in many other variables in this set, positive opinions (there are nine such responses or 50%) dominate, but there are also seven neutral and one negative opinion. Correlations are in Table 66. They are overall less numerous, smaller in size and with lower significances than the first statement.

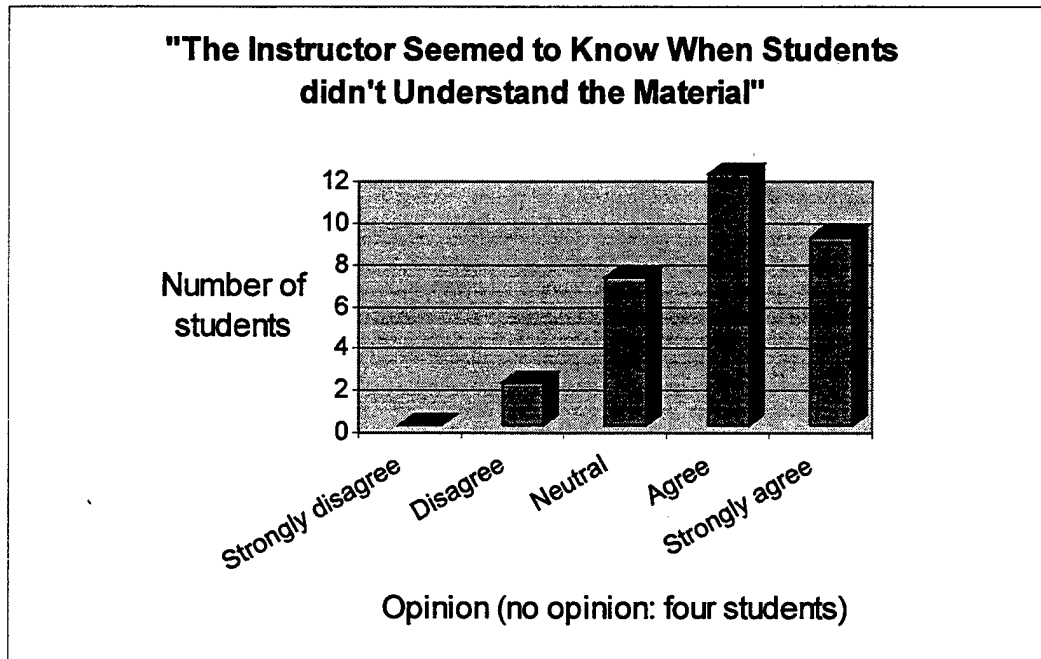


Figure 70. Responses to the Third Statement in the SOFs.

N = 18

Mean = 3.39

Median = 3

Minimum = 2

Maximum = 5

Mode = 3

Statement number	Statement	ρ	p value
11	'The instructor cared about student progress and did his share in helping us to learn'	0.655	0.006
4	'Difficult concepts were made understandable'	0.583	0.018
10	'The instructor stimulated my interest in the subject area.'	0.559	0.025
7	'The instructor was prepared for the course'	0.555	0.026
8	'The instructor's objectives for the course have been made clear'	0.541	0.031
9	'The instructor made this course a worthwhile learning experience'	0.537	0.032
15	'Overall, I would rate the quality of the exams'	0.525	0.037
6	'I felt free to ask questions'	0.486	0.041

Table 66. Correlations and Levels of Significance between Responses to the Third and to the Other Statements (Ordered by Level of Significance).

The next statement in SOFs was the following: 'Difficult concepts were made understandable'. Figure 71 shows the distribution of the responses. Only one student disagreed (strongly) with the statement, and one chose not to answer. Again, there were a number of neutral opinions (seven or 33.33%), but positive ('agree' – nine or 42.86%; 'strongly agree' – four or 19.05%) dominated.

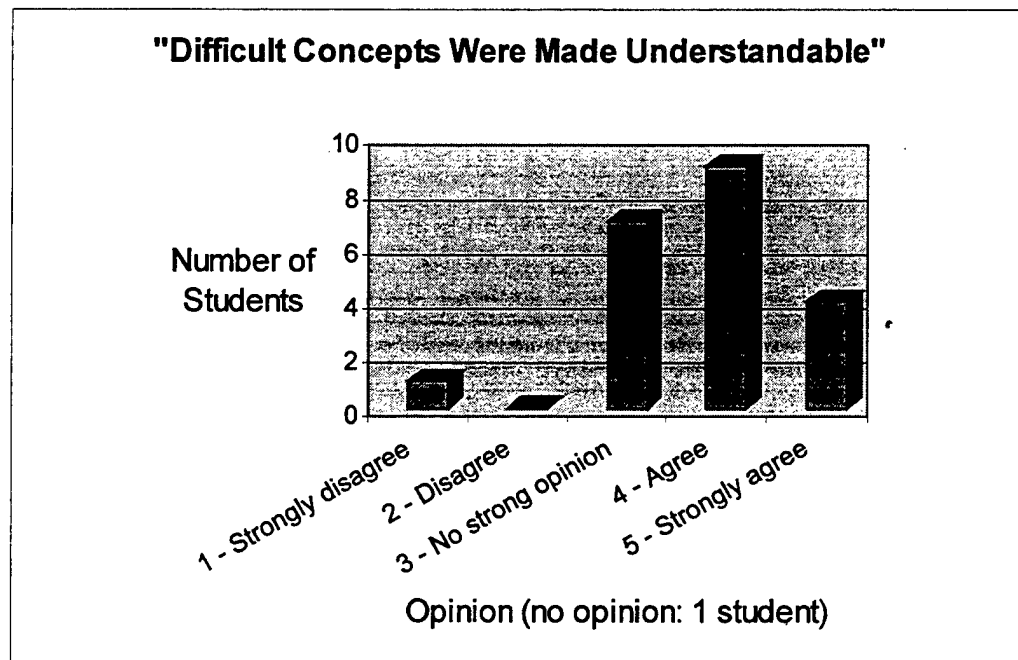


Figure 71. Responses to the Fourth Statement in the SOFs.

N = 21	Mean = 3.71	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

This variable had significant correlations with almost all other variables in the instrument (Table 67). The highest correlations were with 'overall course organizational indicators': overall course rating, how the instructor prepared for the course, and the course organization.

Statement number	Statement	ρ	p value
13	'Overall, I would rate this course'	0.766	< 0.001
7	'The instructor was prepared for the course'	0.749	< 0.001
1	'The course was well organized'	0.677	< 0.001
10	'The instructor stimulated my interest in the subject area'	0.653	0.001
6	'I felt free to ask questions'	0.689	0.002
9	'The instructor made this course a worthwhile learning experience'	0.567	0.007
15	'Overall, I would rate the quality of the exams'	0.578	0.010
3	'The instructor seemed to know when students didn't understand the material'	0.583	0.018
8	'The instructor's objectives for the course have been made clear'	0.507	0.019
11	'The instructor cared about student progress and did his share in helping us to learn'	0.504	0.020
12	'Overall, I would rate the instructor'	0.486	0.030
5	'I had confidence in the instructor's knowledge of the subject'	0.481	0.032
14	'Overall, I would rate the textbook'	0.467	0.033

Table 67. Correlations and Levels of Significance between Responses to the Fourth and to the Other Statements (Ordered by Level of Significance).

The fifth question ('I had confidence in the instructor's knowledge of the subject') had almost only positive student responses: fifteen of them (71.43%) chose 'strongly agree' and five (23.81%) 'agree'. Only one decided to give a neutral response, and another chose not to respond. Figure 72 shows the distribution of the responses, and Table 68 lists all the significant correlations with other variables in the instrument. There are eleven correlations with a level of significance under 0.05. Interestingly, the highest correlation is with responses to the question about feeling free to ask the instructor questions. This is to say, the more students had confidence in the instructor's knowledge and expertise, the more they felt free to ask her questions within the course context. Another high correlation was with responses to the first question about the overall

organization of the course. If the students see the course as better organized, the more they felt free to ask the instructor questions.

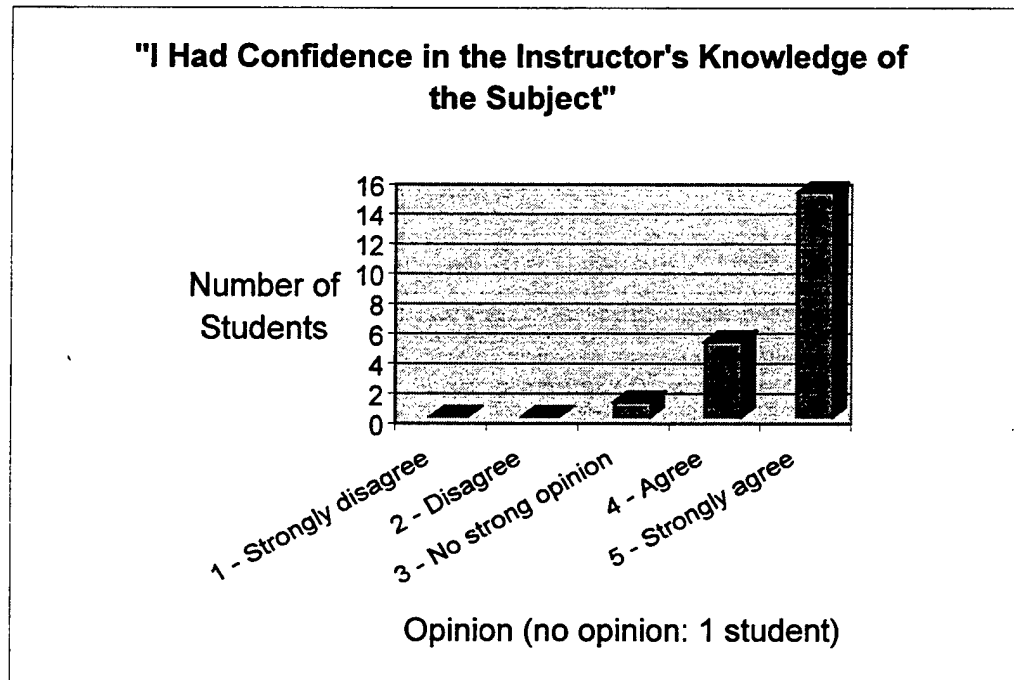


Figure 72. Responses to the Fifth Statement in the SOFs.

N = 21	Mean = 4.67	Median = 5
Minimum = 3	Maximum = 5	Mode = 5

Statement number	Statement	ρ	p value
6	'I felt free to ask questions'	0.800	< 0.001
1	'The course was well organized'	0.702	< 0.001
11	'The instructor cared about student progress and did his share in helping us to learn'	0.628	0.002
8	'The instructor's objectives for the course have been made clear'	0.606	0.003
10	'The instructor stimulated my interest in the subject area'	0.548	0.010
9	'The instructor made the course a worthwhile learning experience'	0.535	0.012
7	'The instructor was prepared for the course'	0.550	0.018
12	'Overall, I would rate the instructor'	0.487	0.025
4	'Difficult concepts were made understandable'	0.481	0.032
15	'Overall, I would rate the quality of the exams'	0.459	0.042
14	'Overall, I would rate the textbook'	0.434	0.049

Table 68. Correlations and Levels of Significance between Responses to the Fifth and to the Other Statements (Ordered by Level of Significance).

I already mentioned the next question ('I felt free to ask questions') when commenting on the previous question. All the responses to this question about feeling free to ask the instructor questions during the course were positive – 14 'strongly agree' and 8 'agree' (Figure 73). The issue of the instructor's very high responsiveness to the students was mentioned a number of times in the interviews. Eleven correlations were significant, and four correlations had p 0.001 or less (Table 69).

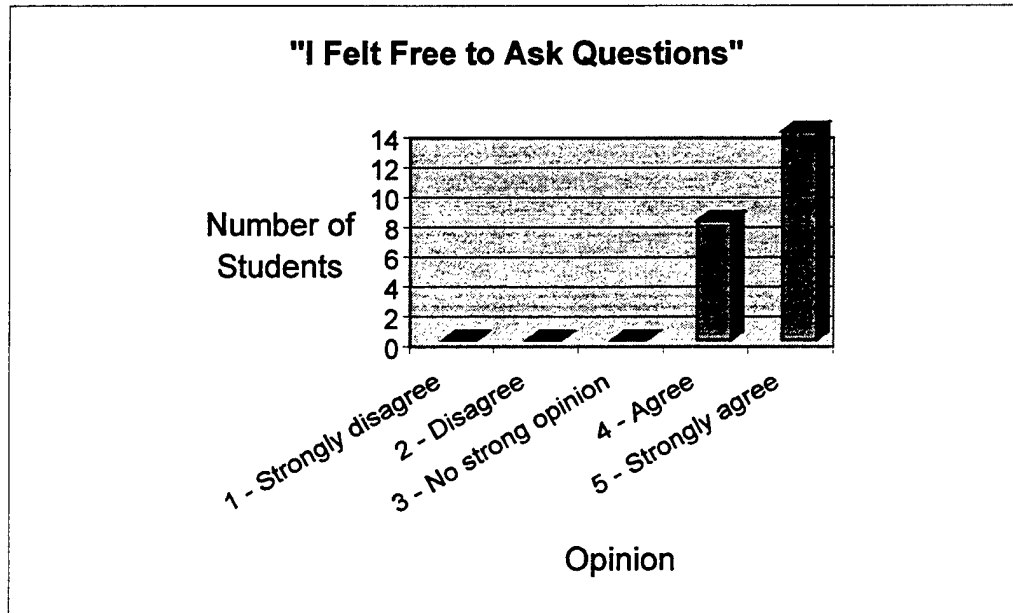


Figure 73. Responses to the Sixth Statement in the SOFs.

N = 22 Mean = 4.64 Median = 5
 Minimum = 4 Maximum = 5 Mode = 5

Statement number	Statement	ρ	p value
5	'I had confidence in the instructor's knowledge of the subject'	0.800	< 0.001
7	'The instructor was prepared for the course'	0.729	< 0.001
8	'The instructor's objectives for the course have been made clear'	0.719	< 0.001
1	'The course was well organized'	0.644	0.001
4	'Difficult concepts were made understandable'	0.689	0.002
15	'Overall, I would rate the quality of the exams'	0.659	0.002
12	'Overall, I would rate the instructor'	0.630	0.002
11	'The instructor cared about student progress and did his share in helping us to learn'	0.628	0.002
10	'The instructor stimulated my interest in the subject area'	0.579	0.005
9	'The instructor made the course a worthwhile learning experience'	0.570	0.006
3	'The instructor seemed to know when students didn't understand the material'	0.486	0.041

Table 69. Correlations and Levels of Significance between Responses to the Sixth and to Other Statements (Ordered by Level of Significance).

Responses to the sixth question most highly correlated with responses concerning the students' view of the instructor's knowledge, her preparation for the course, her making the objectives clear, and with views on the overall organization of the course.

The seventh question was about the instructor's preparedness for the course.

Figure 74 shows the distribution of the responses.

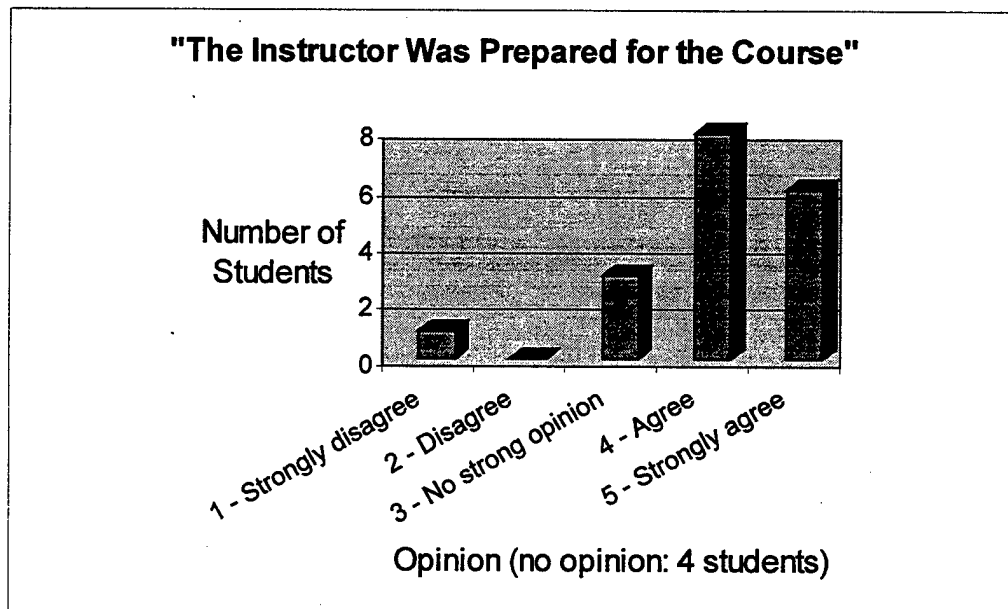


Figure 74. Responses to the Seventh Statement in the SOFs.

N = 18	Mean = 4.00	Median = 4
Minimum = 1	Maximum = 5	Mode = 4

Only one student (5.56%) responded with disagree (strongly) with the seventh statement. Three students (16.67%) chose neutral responses, and four other students (22.22%) decided not to respond ('No comment'). However, correlations (Table 70) are numerous and some very high (six of them with p under 0.001). It could be concluded that the correlations of student responses to all other variables covered in the SOFs reflect very important, and maybe a central role with this issue within the overall context of the course. Students clearly think that the instructor's preparedness has a strong connection

with the organization of the course (statement 1), quality of exams (statement 15), making difficult concepts understandable (statement 4), freedom to ask questions (statement 6), and overall rating of the course (statement 13).

Statement number	Statement	ρ	p value
1	'The course was well organized'	0.860	< 0.001
15	'Overall, I would rate the quality of the exams'	0.830	< 0.001
13	'Overall, I would rate this course'	0.777	< 0.001
4	'Difficult concepts were made understandable'	0.749	< 0.001
6	'I felt free to ask questions'	0.729	< 0.001
10	'The instructor stimulated my interest in the subject area'	0.715	< 0.001
9	'The instructor made the course a worthwhile learning experience'	0.677	0.002
8	'The instructor's objectives for the course have been made clear'	0.662	0.003
12	'Overall, I would rate the instructor'	0.632	0.005
14	'Overall, I would rate the textbook'	0.562	0.015
5	'I had confidence in the instructor's knowledge of the subject'	0.550	0.018
3	'The instructor seemed to know when students didn't understand the material'	0.555	0.026
11	'The instructor cared about student progress and did his share in helping us to learn'	0.503	0.033

Table 70. Correlations and Levels of Significance between Responses to the Seventh and to the Other Statements (Ordered by Level of Significance).

The eighth statement was 'The instructor's objectives for the course have been made clear'. Although most of students responded with 'Strongly agree' (ten of them or over 45%), other responses were dispersed over all the other categories (Figure 75). Two students (9.09%) strongly disagreed and one disagreed. Four students (18.18%) chose neutral responses. In summary, more student responses were positive (total of 15 students or 68.18%) than neutral or negative (seven students or less than 32%).

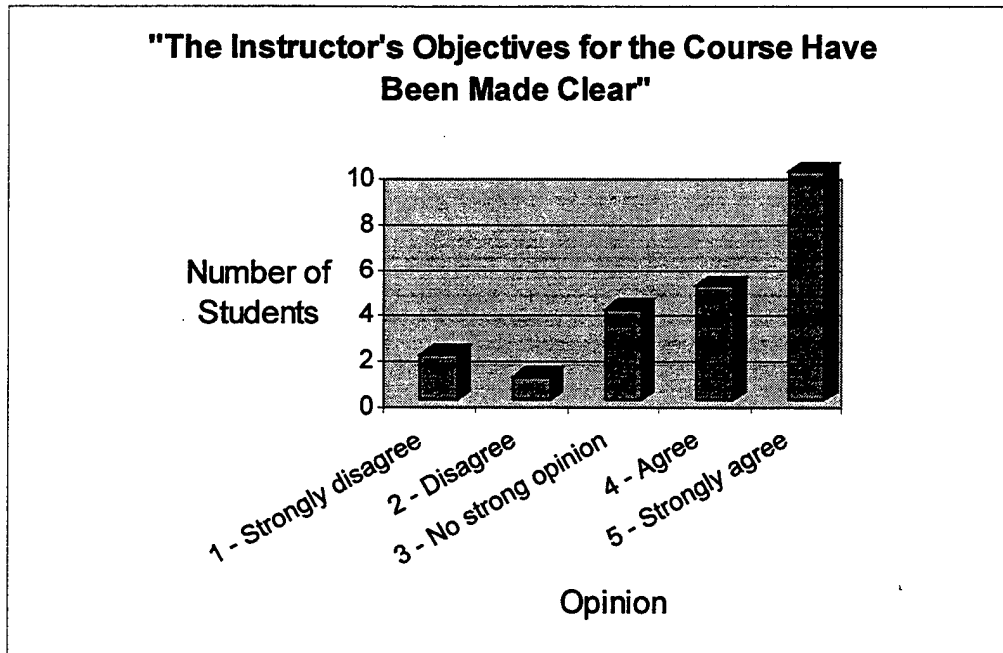


Figure 75. Responses to the Eighth Statement in the SOFs.

N = 22	Mean = 3.91	Median = 4
Minimum = 1	Maximum = 5	Mode = 5

Interestingly, the variables having the highest correlations (Table 71) with responses to this statement (statements number 10, 9 and 11) are close by their content to the instructor's approach to the learning process. Through my contacts and interviews with the instructor I realized she invested energy to make the course very stimulating to students, a worthwhile learning experience, and she cared about the student progress. More a student understood the learning objectives of the course, better he or she could understand the instructor's top priorities, what these correlations confirm.

It would be interesting to examine in depth intercorrelations of these variables, but the data (small sample, ordered categorical variables) do not permit more sophisticated mathematical-analytical methods for extracting underlying dimensions and relationships.

Statement number	Statement	ρ	p value
10	'The instructor stimulated my interest in the subject area'	0.810	< 0.001
9	'The instructor made this course a worthwhile learning experience'	0.752	< 0.001
11	'The instructor cared about student progress and did his share in helping us to learn'	0.745	< 0.001
1	'The course was well organized'	0.724	< 0.001
6	'I felt free to ask questions'	0.719	< 0.001
13	'Overall, I would rate the course'	0.651	0.001
12	'Overall, I would rate this course'	0.656	0.002
7	'The instructor was prepared for the course'	0.662	0.003
5	'I had confidence in the instructor's knowledge of the subject'	0.606	0.003
14	'Overall, I would rate the quality of the exams'	0.569	0.006
15	'Overall, I would rate the quality of the exams'	0.528	0.014
4	'Difficult concepts were made understandable'	0.507	0.019
3	'The instructor seemed to know when students didn't understand the material'	0.541	0.031

Table 71. Correlations and Levels of Significance between Responses to the Eighth and to the Other Statements (Ordered by Level of Significance).

The ninth statement ('The instructor made this course a worthwhile learning experience') also produced dispersed student responses, with 'strongly agree' responses as in the previous question, but with other differences in distribution. Three students (13.64%) disagreed with the statement (two 'strongly disagreed' and one 'disagreed') and five (22.73%) chose a neutral response (Figure 76). Significant correlations with respective significance levels are in Table 72. There are numerous significant correlations, and six of them have p equal or less than 0.001.

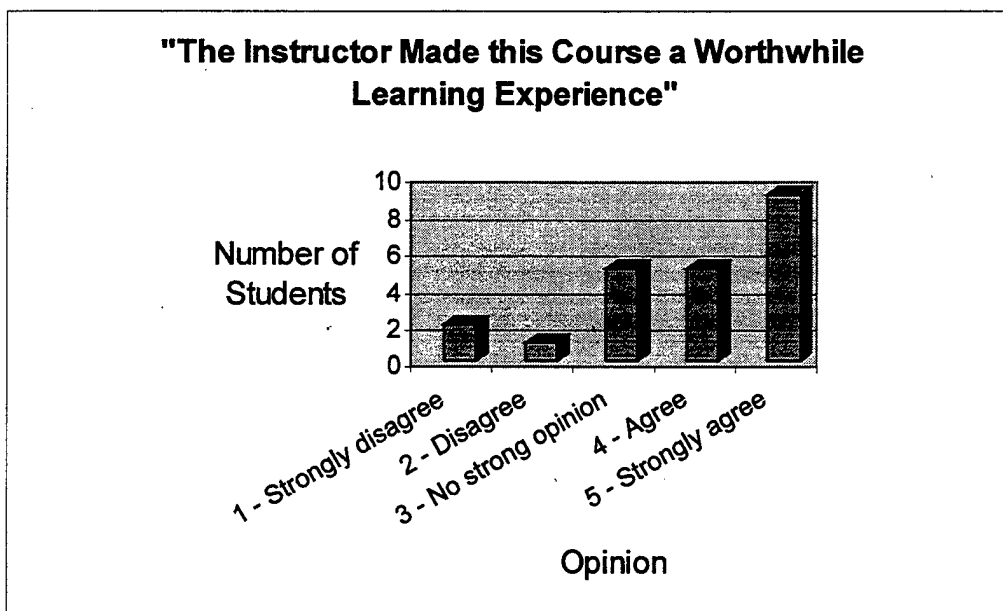


Figure 76. Responses to the Ninth Statement in the SOFs.

N = 22 Mean = 3.82 Median = 4
 Minimum = 1 Maximum = 5 Mode = 5

Statement number	Statement	ρ	p value
12	'The instructor cared about student progress and did his share in helping us to learn'	0.833	< 0.001
11	'The instructor stimulated my interest in the subject area'	0.816	< 0.001
1	'The course was well organized'	0.762	< 0.001
8	'The instructor's objectives for the course have been made clear'	0.752	< 0.001
10	'The instructor made the course a worthwhile learning experience'	0.691	< 0.001
13	'Overall, I would rate this course'	0.672	0.001
7	'The instructor was prepared for the course'	0.677	0.002
14	'Overall, I would rate the textbook'	0.600	0.003
6	'I felt free to ask questions'	0.570	0.006
5	'I had confidence in the instructor's knowledge of the subject'	0.535	0.012
15	'Overall, I would rate the quality of the exams'	0.528	0.016
3	'The instructor seemed to know when students didn't understand the material'	0.537	0.032

Table 72. Correlations and Levels of Significance between Responses to the Ninth and to the Other Statements (Ordered by Level of Significance).

The question whether the instructor stimulated students' interest in the subject area was next. Two students (9.09%) disagreed (one strongly), and six students (27.27%) chose neutral responses (Figure 77).

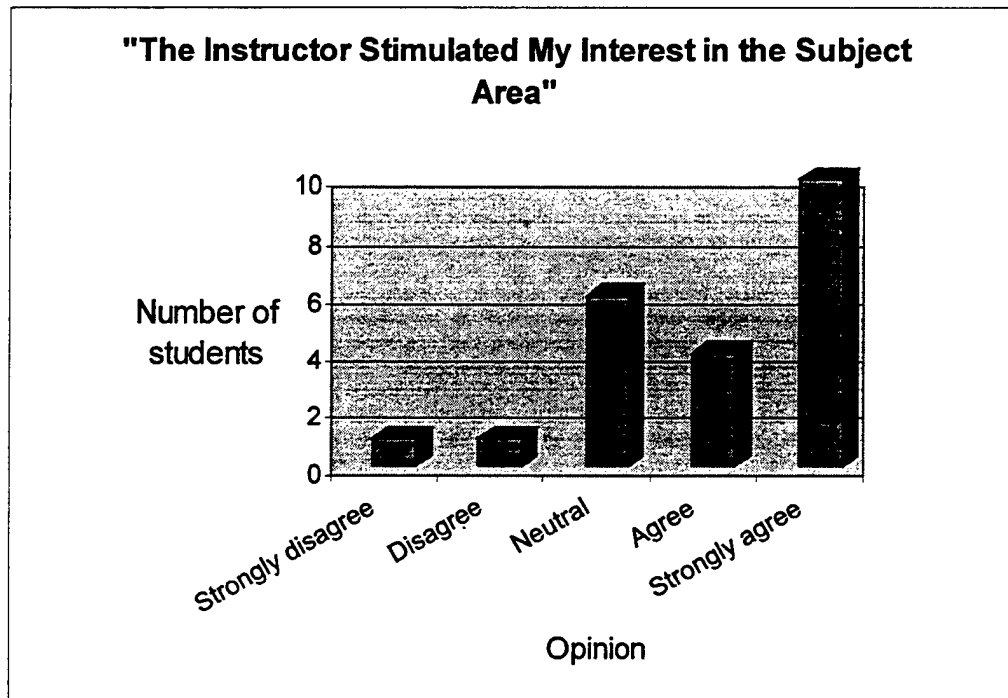


Figure 77. Responses to the Tenth Statement in the SOFs.

N = 22	Mean = 3.95	Median = 4
Minimum = 1	Maximum = 5	Mode = 5

All significant correlations with other variables are listed in Table 73. They were numerous with seven of them having p equal or less than 0.001.

Statement number	Statement	ρ	p value
8	'The instructor's objectives for the course have been made clear'	0.810	< 0.001
13	'Overall, I would rate the course'	0.746	< 0.001
7	'The instructor was prepared for the course'	0.715	< 0.001
9	'The instructor made this course a worthwhile learning experience'	0.691	< 0.001
11	'The instructor cared about student progress and did his share in helping us to learn'	0.679	0.001
4	'Difficult concepts were made understandable'	0.653	0.001
1	'The course was well organized'	0.649	0.001
6	'I felt free to ask questions'	0.579	0.005
12	'Overall, I would rate the instructor'	0.570	0.007
5	'I had confidence in the instructor's knowledge of the subject'	0.548	0.010
3	'The instructor seemed to know when students didn't understand the material'	0.559	0.025
15	'Overall, I would rate the quality of the exams'	0.503	0.027
14	'Overall, I would rate this textbook'	0.471	0.027

Table 73. Correlations and Levels of Significance between Responses to the Tenth and to the Other Statements (Ordered by Level of Significance)

It is interesting to note an exceptionally high correlation between the tenth and eighth statement. In the students' opinion, the clearer the instructor made course objectives, the more stimulated the students felt.

The eleventh statement in the Student Opinion Forms was the following: 'The instructor cared about student progress and did his share in helping us to learn'. Figure 78 shows the distribution of the student responses. Nineteen students (86.36%) agreed with the statement, nine of them 'strongly'. Only three students (13.64%) chose neutral responses, and none disagreed.

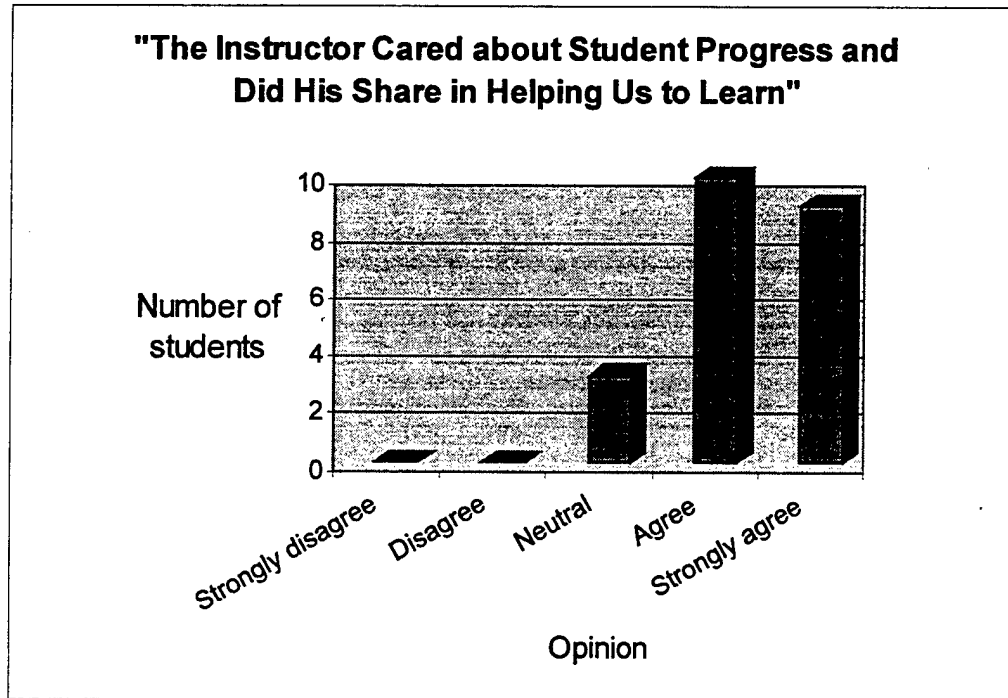


Figure 78. Responses to the Eleventh Statement in the SOFs.

N = 22	Mean = 4.36	Median = 4
Minimum = 3	Maximum = 5	Mode = 4

Table 74 shows significant correlations with other variables. Eleven correlations were significant with p under 0.05, and five had p equal or less than 0.001. The highest was the correlation with responses about the instructor making the course a worthwhile learning experience.

Statement number	Statement	ρ	p value
9	'The instructor made the course a worthwhile learning experience'	0.816	< 0.001
8	'The instructor's objectives for the course have been made clear'	0.745	< 0.001
12	'Overall, I would rate the instructor'	0.658	< 0.001
10	'The instructor made the course a worthwhile learning experience'	0.679	0.001
1	'The course was well organized'	0.654	0.001
5	'I had confidence in the instructor's knowledge of the subject'	0.628	0.002
6	'I felt free to ask questions'	0.628	0.002
3	'The instructor seemed to know when students didn't understand the material'	0.655	0.006
13	'Overall, I would rate the course'	0.510	0.015
15	'Overall, I would rate the textbook'	0.481	0.032
7	'The instructor was prepared for the course'	0.503	0.033

Table 74. Correlations and Levels of Significance between Responses to the Eleventh and to the Other Statements (Ordered by Level of Significance).

Five five-point rating scale questions followed after the first eleven statements. In them the students rated the instructor, the course, the textbook, and the quality of the exams. The last scale about the laboratories was disregarded. There were no special 'laboratory activities'.

The first question rated the instructor (Figure 79). Ratings were very positive. Seven students (33.33%) rated the instructor as 'outstanding' and nine (42.86%) as 'excellent'. Only one student (4.76%) chose 'fair', one did not rate the instructor, and the remaining students (four of them or 19.05%) chose 'about average'. Looking at the correlations (Table 75), we can conclude that in their rating of the instructor, the students mostly considered if they thought the course was 'a worthwhile learning experience'. Nine other correlations were significant.

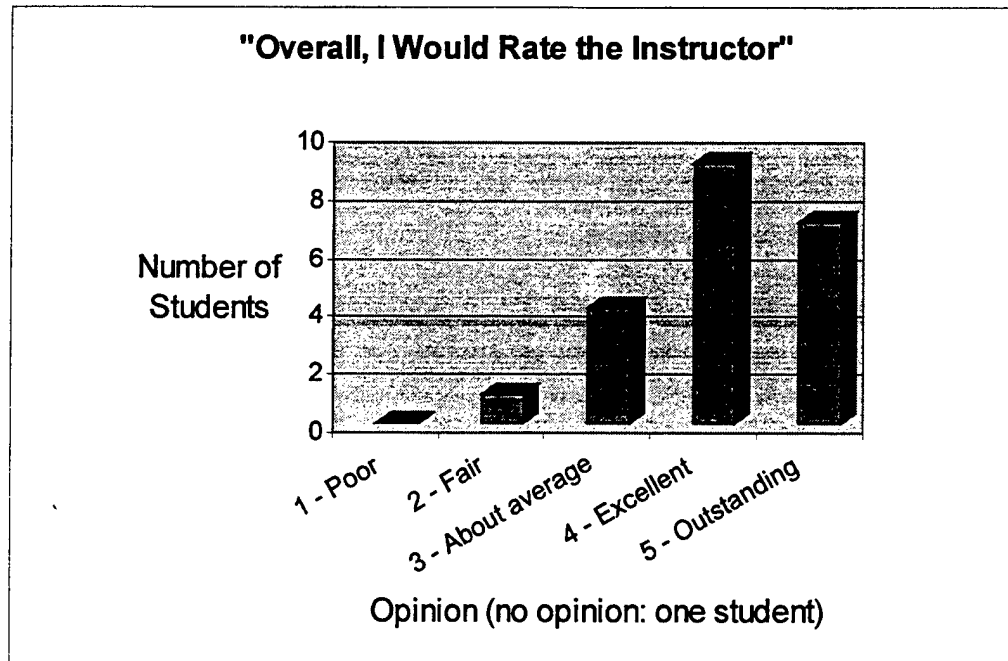


Figure 79. Responses to the Twelfth Statement/Scale in the SOFs.

N = 21 Mean = 4.05 Median = 4
 Minimum = 2 Maximum = 5 Mode = 4

Statement number	Statement	ρ	p value
9	'The instructor made the course a worthwhile learning experience'	0.833	< 0.001
1	'The course was well organized'	0.648	< 0.001
11	'The instructor cared about student progress and did his share in helping us to learn'	0.658	0.001
8	'The instructor's objectives for the course have been made clear'	0.656	0.002
6	'I felt free to ask questions'	0.630	0.002
7	'The instructor was prepared for the course'	0.632	0.005
10	'The instructor stimulated my interest in this subject area'	0.570	0.007
13	'Overall, I would rate this course'	0.564	0.008
14	'Overall, I would rate the textbook;	0.498	0.022
5	'I had confidence in the instructor's knowledge of the subject'	0.487	0.025

Table 75. Correlations and Levels of Significance between Responses to the Twelfth and to the Other Statements (Ordered by Level of Significance).

The students' view of the course visibly differs from their view of the instructor. The students rated the course less favorably than they rated the instructor (Figure 80).

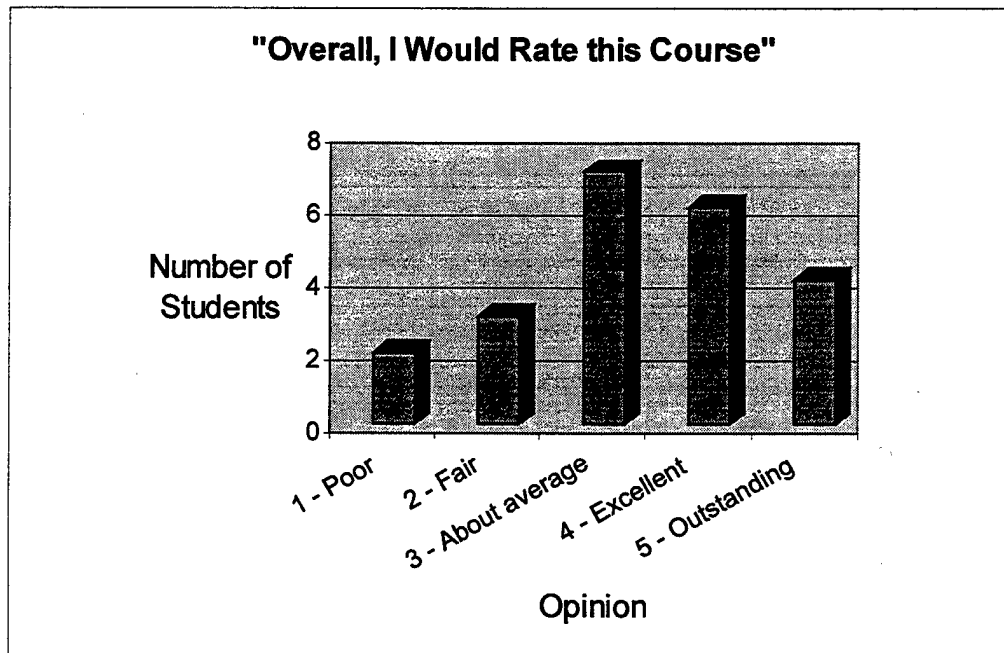


Figure 80. Responses to the Thirteenth Statement/Scale in the SOFs.

N = 22	Mean = 3.32	Median = 3
Minimum = 1	Maximum = 5	Mode = 3

Five students (27.73%) rated the course below average, while only one student (4.55%) rated the instructor below average. Four students (18.18%) rated the course as 'outstanding', while seven students (31.82%) chose the same response rating for the instructor.

A possible conclusion from this data is that there are some undesirable elements within the course that were not a direct consequence of the instructor's approach, knowledge, teaching or communication skills. An additional and/or alternative explanation could be that the student rating of the instructor is more about the instructor's personality, and rating of the course is more about every other factor relevant to the

course's success. However, significant associations among all aspects of the course covered with SOFs clearly show that it would be extremely difficult to distinguish the subtle factors students take into consideration when assessing course quality. Table 76 shows significant correlations of the student course rating with other variables.

Statement number	Statement	ρ	p value
7	'The instructor was prepared for the course'	0.777	< 0.001
4	'Difficult concepts were made understandable'	0.766	< 0.001
1	'The course was well organized'	0.671	< 0.001
9	'The instructor made the course a worthwhile learning experience'	0.672	0.001
8	'The instructor's objectives for the course have been made clear'	0.651	0.001
10	'The instructor stimulated my interest in this subject area'	0.633	0.002
14	'Overall, I would rate the textbook;	0.565	0.006
12	'Overall, I would rate the instructor'	0.564	0.008
11	'The instructor cared about student progress and did his share in helping us to learn'	0.510	0.015
15	'Overall, I would rate the quality of the exams'	0.525	0.017
6	'I felt free to ask questions'	0.512	0.015

Table 76. Correlations and Levels of Significance between Responses to the Thirteenth and to the Other Statements (Ordered by Level of Significance).

The fourteenth scale asked the students to rate the textbook. With the SS3011 course, one main textbook was used. The majority of the students (Figure 81) rated the textbook as 'excellent' (twelve students or 54.55%) or 'outstanding' (six students or 27.27%), but two students (9.90%) saw the textbook as 'below average'. There were also two (9.09%) 'about average' responses.

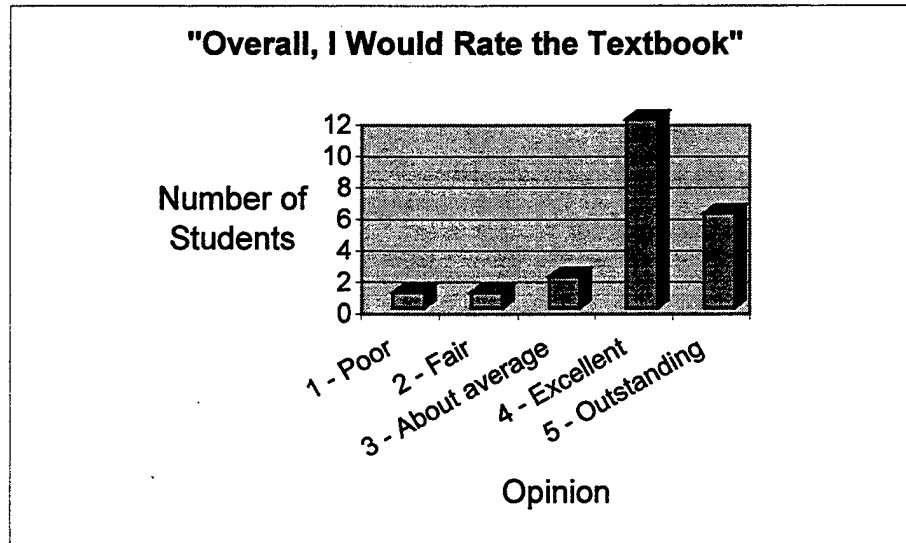


Figure 81. Responses to the Fourteenth Statement/Scale in the SOFs.

N = 22 Mean = 3.95 Median = 4
 Minimum = 1 Maximum = 5 Mode = 4

Table 77 shows significant correlations with other variables. There were nine significant correlations, with the highest correlation with the first statement about the organization of the course.

Statement number	Statement	ρ	p value
1	'The course was well organized'	0.726	< 0.001
9	'The instructor made the course a worthwhile learning experience'	0.600	0.003
8	'The instructor's objectives for the course have been made clear'	0.569	0.006
13	'Overall, I would rate this course'	0.565	0.006
7	'The instructor was prepared for the course'	0.562	0.015
12	'Overall, I would rate the instructor'	0.498	0.022
10	'The instructor stimulated my interest in this subject area'	0.471	0.027
4	'Difficult concepts were made understandable'	0.467	0.033
5	'I had confidence in the instructor's knowledge of the subject'	0.434	0.049

Table 77. Correlations and Levels of Significance between Responses to the Fourteenth and to the Other Statements (Ordered by Level of Significance).

The last scale in this instrument used in this research asked the students about the quality of the exams (Figure 82). Responses varied from 'fair' (three or 15%) to 'outstanding' (two or 10.00%), with 'above average' responses dominating (eleven students or 55.00%). Two students did not choose any opinion.

Eleven correlations were significant (Table 78). The highest correlations were with the student's view of the instructor's preparedness for the course (seventh statement) and with their view of the overall organization of the course (first statement).

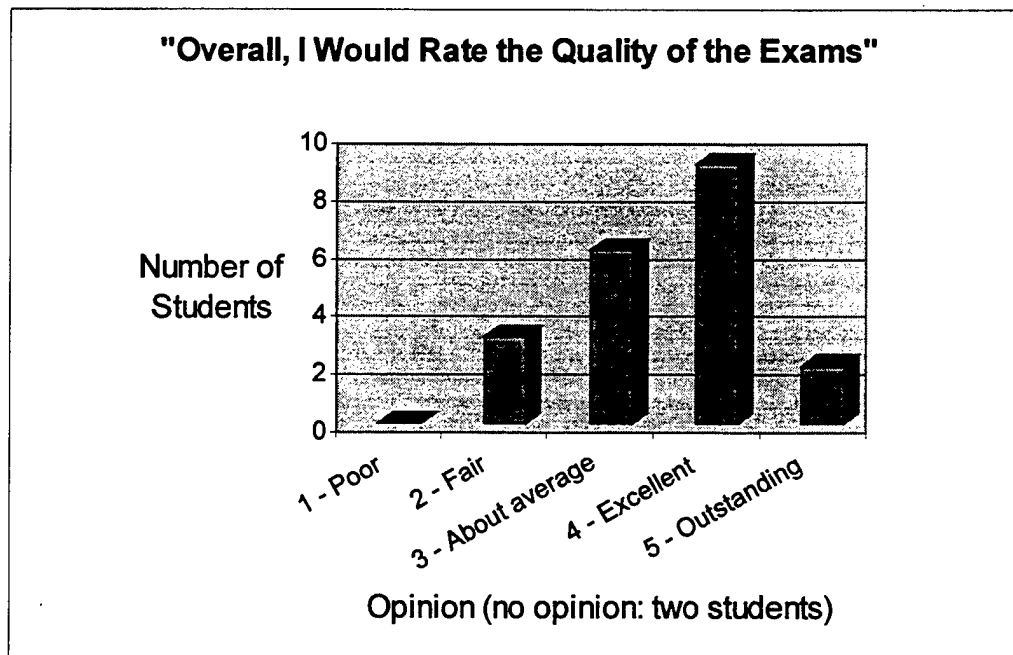


Figure 82. Responses to the Fifteenth Statement/Scale in the SOFs.

N = 20	Mean = 3.50	Median = 4
Minimum = 2	Maximum = 5	Mode = 4

Statement number	Statement	ρ	p value
7	'The instructor was prepared for the course'	0.830	< 0.001
1	'The course was well organized'	0.702	< 0.001
6	'I felt free to ask questions'	0.659	0.002
4	'Difficult concepts were made understandable'	0.578	0.010
8	'The instructor's objectives for the course have been made clear'	0.528	0.014
9	'The instructor made the course a worthwhile learning experience'	0.529	0.016
13	'Overall, I would rate this course'	0.525	0.017
10	'The instructor stimulated my interest in this subject area'	0.503	0.024
11	'The instructor cared about student progress and did his share in helping us to learn'	0.481	0.032
3	'The instructor seemed to know when students didn't understand the material'	0.525	0.037
5	'I had confidence in the instructor's knowledge of the subject'	0.459	0.042

Table 78. Correlations and Levels of Significance between Responses to the Fifteenth and to the Other Statements (Ordered by Level of Significance).

SOFs also offer students a possibility to add their own comments. Fifteen students gave comments. After analysis of their content, I divided the comments to three groups:

Mostly positive opinions

- Overall, this was an excellent course. It is crucial however to have backup systems. We lost our rhythm when the site went down.
- Started out as excellent class - web site being down (new online course - somewhat under standing) greatly hampered the flexibility of the course -> which is supposed to be one of the benefits for an online course.
- I appreciate the flexibility of the DL format. Cdr Higgins did an excellent job in presenting this class in its first on-line format. I learned just as much or more than I would have learned in a traditional classroom setting and I was afforded the opportunity to do the work as my schedule allowed. If given the opportunity, I would choose to enroll in other on-line courses as well.

Neutral and mixed opinion

- # 3¹⁶. I have no strong opinion on this question. Instructor's gage on student progress was based on forum input, quiz scores and evaluations. If separate contact was made to students doing poorly, I don't know.
- This course needs more time to develop if it is to be offered on-line exclusively. I am not a proponent of the on-line format as an exclusive means of instruction AT a university. It should be used to alignment classroom instruction. I do, however, support its use as a distance learning tool.
- Took the on-line version of course. As an ITM student, I was just looking for a god overview of space systems, and that's what the course delivered. Anyone looking for MORE than an overview would likely not get what they needed in the online version. This is not a commentary on the instructor, she was great, more a commentary on not being able to interact one-on-one, etc.
- Constant small group interaction is the key to staying in touch with the course - the more the better. I did not do my part, but this was a worthwhile learning experience. Spread myself too thin this quarter; this class did not get the attention that it deserves.
- First iteration, so I know this, but need to insole no software bugs at UCF. Also recommend tests every week. While I appreciated the break, it allowed my interaction (especially with readings) to slide. Overall good experience.
- Cdr Higgins knows the material. However there were too many technical problems.
- I feel that the online course has its place within a military setting, i.e. on the boat or you are just taking that one class. There is no reason for us to take on on-line course while we are here. It was the first class I blew off when the other classes got busy. I need the classroom interaction in order to learn. I would have rather sat in the classroom and learned something. I feel I got nothing out of the online class.
- If I were to take the course again, I would take the in-class version. I enjoyed the material but felt we didn't get enough conversation in class.

Negative opinions and critiques

- Not a good way for me to learn

¹⁶ It was the statement 'The instructor seemed to know when the students didn't understand the material'.

- Not a good experience at all. Really was a waste of time. Granted it takes a lot of effort on both the instructor and student parts. The technical problems didn't help, but it seemed as if we were going week to week, you can only talk about outsourcing so much. The information covered in modules was not enough to properly complete the final point paper.
- This was a useless class in terms of what we covered. Modules were not ready, they were difficult to access
- Tough 1st go around for online course. Many glitches in the system slowed the pace. Need Quizzes on each module just to keep us honest.

SOFs – Summary

I made several conclusions and methodological remarks from a summary of the analysis of the data from the SOFs.

The responses offered in the SOFs of 'No comment' or 'Not applicable' decreased the statistical power of the qualitative analysis because such responses had to be eliminated from the calculations.

The number of weekly credit hours (sample average: 16.73, minimum 12, maximum 24) and the number of completed quarters (sample average: 4.00, minimum 0, maximum 6) do not have any significant correlation to other variables in the set.

The second statement in the SOFs ('Time in class was spent effectively') is not applicable in DL environments. It should be revised or removed.

The third statement in the SOFs ('The instructor seemed to know when students didn't understand the material') also seems not to be quite appropriate for a DL environment. Its meaning changes for DL courses because of the different nature of the feedback from the instructor.

In general, most of the responses to the different statements in the SOFs significantly correlate. Most significant correlations have statements number one ('The course was well organized'), seven ('The instructor was prepared for the course'), eight ('The instructor's objectives for the course have been made clear'), nine ('The instructor made the course a worthwhile learning experience'), and four ('Difficult concepts were made understandable'). Statement number two ('Time in class was spent effectively') has the lowest number of significant correlations because of the problem stated previously.

Most of the responses were very favorable about the instructor and the course, especially the responses to statement number five ('I had confidence in the instructor's knowledge of the subject'), six ('I felt free to ask questions'), and eleven ('The instructor cared about student progress and did his share in helping us to learn'). To help the reader in reviewing all responses in SOFs, I provide summary table of the student responses (Table 79) at the end of this summary.

Although predominantly positive, responses to the majority (11 of 15) of statements contained some individual negative responses too.

Some individual very high correlations provide interesting insights into relations within the DL course context. For instance, in the student's opinion, the more the instructor made the course objectives clear, the more their interest in the subject area was stimulated. However, the sample size and kind of data available (ordered categories) do not allow for more subtle analysis.

Statements (N = 22)	Frequencies of Responses					
	Strongly disagree / Poor ¹⁷	Disagree / Fair	No strong opinion / About average	Agree / Excellent	Strongly agree / Outstanding	Not applicable / No comment
The course was well organized.	2	1	6	8	5	0
Time in class was spent effectively.	0	0	5	3	1	13
The instructor seemed to know when students didn't understand the material.	0	3	7	6	2	4
Difficult concepts were made understandable.	1	0	7	9	4	1
I had confidence in the instructor's knowledge of the subject.	0	0	1	5	15	1
I felt free to ask questions.	0	0	0	8	15	0
The instructor was prepared for the course.	1	0	3	8	6	4
The instructor's objectives for the course have been made clear.	2	1	4	5	10	0
The instructor made this course a worthwhile learning experience.	2	1	5	5	9	0
The instructor stimulated my interest in the subject area.	1	1	6	4	10	0
The instructor cared about student progress and did her share in helping us to learn.	0	0	3	10	9	0
Overall, I would rate the instructor.	0	1	4	9	7	1
Overall, I would rate this course.	2	3	7	6	4	0
Overall, I would rate the textbook.	1	1	2	12	6	0
Overall, I would rate the quality of the exams.	2	3	6	9	2	0

Table 79. Summary of Student Responses in Student Opinion Forms.

¹⁷ Second responses ('Poor', 'Fair', etc.) apply for last four statements in SOF.

C. STUDENT ON-LINE TRACKING

WebCT software used in the course was able to automatically track the student online activities during the course. I included only data for the thirty students who completed the course in this analysis. Indicators that were interesting for this thesis are:

- Total number of hits, i.e. number of times a student entered the course web pages using his/her logon and password
- Number of visits to the course homepage
- Number of visits to the course content page
- Number of forum articles read, i.e. how many articles in all of forums together a student read
- Number of forum articles posted by a student
- Number of original forum articles posted
- Number of follow-up forum articles posted
- Number of different course pages visited

The first indicator, total number of hits, was widely distributed, from a minimum of 46 to a maximum of 605 hits by one student. Figure 84 shows the distribution. Most students (fifteen or 50.00%) made between 200 and 400 hits during the course, but nine students (30.00%) had over 500 hits. Interestingly, there were two students with less than 100 hits, but they completed the course also.

Since the student tracking was recorded by student names, it was possible to check not only correlations between the student tracking variables, but also with other instruments and variables associated with student names, which includes the First questionnaire, the Module 14 questionnaire, and final grades. In cases where both variables are numeric and not ordered categories, Pearson's r correlation coefficient was calculated with the respective p value, not Spearman's coefficient of rank correlations. The total number of hits had nine statistically significant correlations (Table 80).

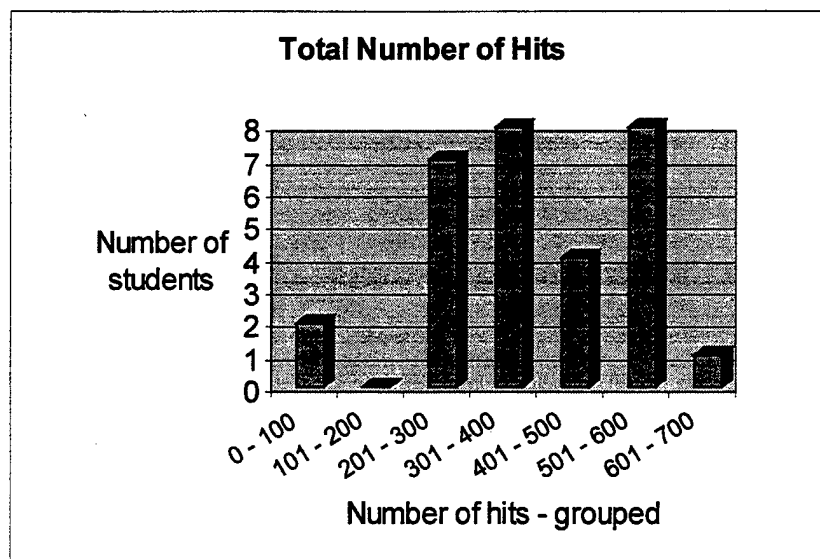


Figure 83. Distribution of the Total Number of Hits.
 N = 30 Mean = 382.93 Minimum = 46
 Maximum = 605 Standard dev. = 149.97

Instrument	Variable / Question	ρ / r	p value
Student tracking	Number of forum articles read.	$r = 0.711$	< 0.001
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.581$	0.001
Student tracking	Number of visits to the course content page.	$r = 0.512$	0.004
Student tracking	Number of visits to the course homepage.	$r = 0.463$	0.010
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	$\rho = 0.411$	0.015
Module 14	8 - 'How would you rate your comfort level at this point with accessing the Internet?'	$\rho = 0.425$	0.019
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.404$	0.021
Student tracking	Number of different pages visited.	$r = 0.395$	0.031
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	$\rho = 0.387$	0.034

Table 80. Significant Correlations and Levels of Significance between the Total Number of Hits and Other Variables (Ordered by Level of Significance).

From this table we can see that students who accessed the on-line course materials strongly tended to read a larger number of forum articles. Also, they felt more comfortable with quizzes, with posting to forums, accessing the Internet, and sending e-mail. Also, they tended to visit more different pages in the on-line course material.

The second student tracking indicator was the number of visits to the course homepage. The mean of this variable is much lower than the mean of the total number of hits because it was possible to use on-line course materials without visiting the course homepage by using favorites or bookmarks in the Internet browser software. Another possibility is, in the case of a lost connection to the Internet (e.g., the TCP-IP connection), to logon again without reopening the homepage.

Figure 84 shows the distribution of the visits to the course homepage. There were fewer and fewer students as number of homepage visits increase (75-104 visits – eight students or 26.67%; 105-134 visits – six students or 20.00%; 135-164 visits – four students or 13.33%), but there were also two students (6.67%) with a very low number of visits. This indicator had significant correlations with eleven other variables (Table 81): six other student tracking indicators, comfort levels with accessing the Internet, posting to forums, sending e-mail, and even the number of quarters enrolled. The latter have a negative sign, which means that more senior NPS students tended to visit the course homepage less, which might mean that they were more able to use course materials without starting from the course homepage. There are no clear indicators to support this explanation.

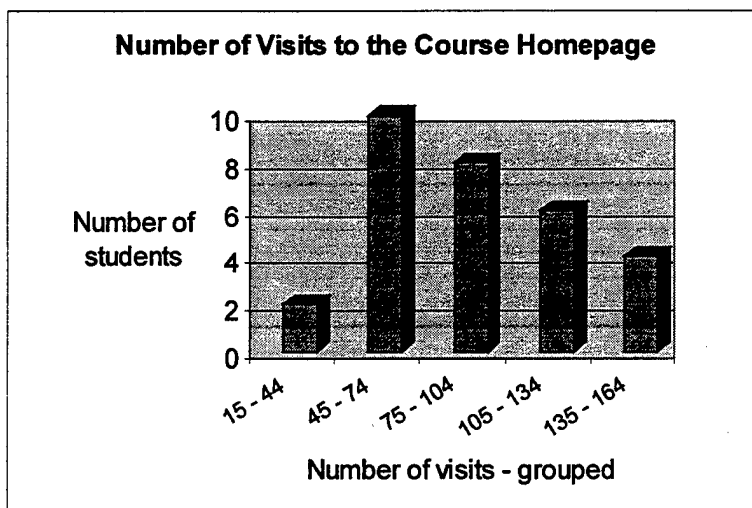


Figure 84. Distribution of Visits to the Course Homepage.

N = 30

Mean = 90.80

Minimum = 15

Maximum = 160

Standard dev. = 35.69

Instrument	Variable / Question	ρ / r	p value
Student tracking	Number of original posts to the forums.	$r = 0.619$	< 0.001
Student tracking	Number of visits to the course content page.	$r = 0.553$	0.002
Student tracking	Number of different pages visited.	$r = 0.514$	0.004
Student tracking	Number of articles posted to the forums.	$r = 0.508$	0.004
First questionnaire	Total number of quarters enrolled	$r = -0.479$	0.007
Module 14	8 - 'How would you rate your comfort level at this point with accessing the Internet?'	$\rho = 0.475$	0.008
Student tracking	Total number of hits.	$r = 0.463$	0.010
Student tracking	Number of the forums articles read.	$r = 0.442$	0.015
Module 14	6 - 'Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum.'	$\rho = 0.408$	0.025
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	$\rho = 0.406$	0.026
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	$\rho = 0.400$	0.029

Table 81. Significant Correlations and Levels of Significance between the Total Number of Visits to the Course Homepage and Other Variables (Ordered by Level of Significance).

The number of visits to the course content page had almost in shape of a normal distribution (Figure 85). This variable had only three significant correlations (Table 82). Only correlations with other student tracking indicators were significant.

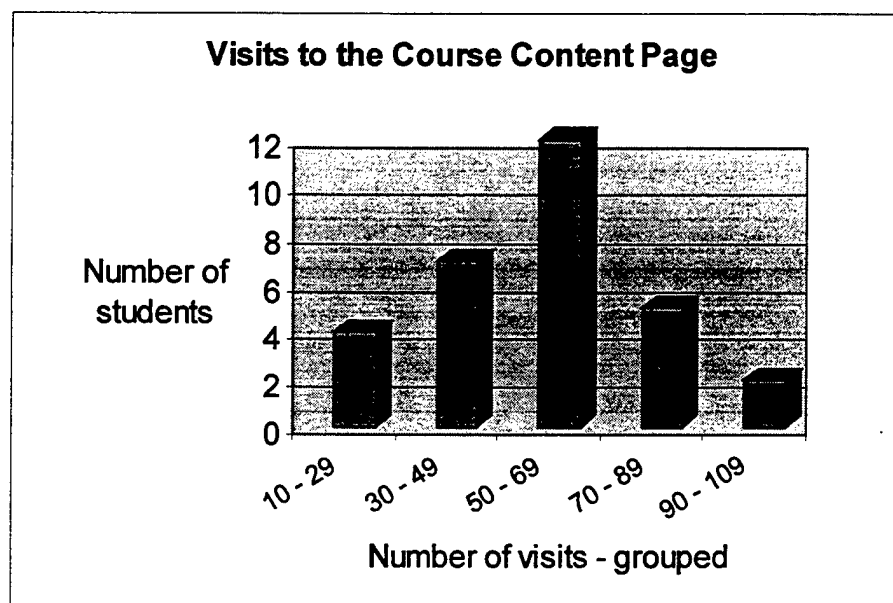


Figure 85. Distribution of Visits to the Course Content Page.

N = 30

Mean = 56.87

Minimum = 16

Maximum = 99

Standard dev. = 21.33

Instrument	Variable	r	p value
Student tracking	Number of different pages visited.	r = 0.716	< 0.001
Student tracking	Number of visits to the course homepage.	r = 0.553	0.002
Student tracking	Total number of hits.	r = 0.512	0.004

Table 82. Significant Correlations and Levels of Significance between the Total Number of Different Pages Visited and Other Variables (Ordered by Level of Significance).

The number of forum articles read (accessed) had an extremely wide range – from only eight up to 423 forum articles (Figure 87). The total number of articles in the course forums was 585, but 34 of them were not available to the students. Only the course management staff and the instructor could access them. Also, when the instructor broke forum exercises into smaller groups, only members of assigned groups and the instructor could access their respective forums. In other words, a maximum of 423 accessed forum articles is very close to a theoretical maximum a student could access during the course.

Eight correlations were significant (Table 83), and they include two other student tracking indicators, five comfort levels from the Module 14 questionnaire (word processing, quiz, accessing the Internet, sending e-mail, and posting to Forums), and self-perceived computer proficiency from the First questionnaire.

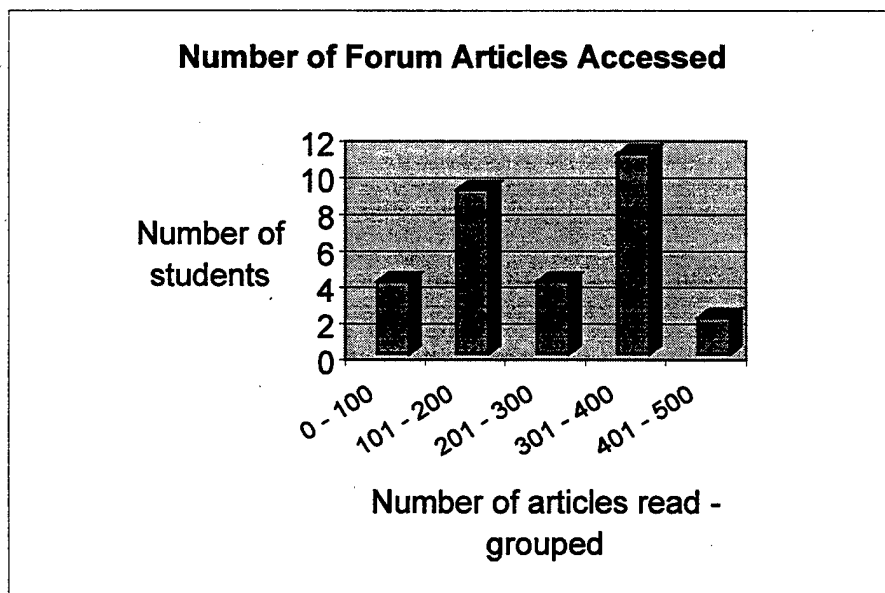


Figure 86. Distribution of the Number of Forum Articles Read.

N = 30

Mean = 239.20

Minimum = 8

Maximum = 423

Standard dev. = 116.09

The next item was the total number of articles posted to the forums. The total number can be divided into original posts and follow-up posts, which cause two other indicators to be used in this data analysis. Figure 87 shows the distribution of the numbers of posted articles. On average, a student posted approximately 14 to 15 articles. Most of the students posted between 5 and 20, but the total range is from one to 31 articles.

Instrument	Variable / Question	ρ / r	p value
Student tracking	Total number of hits.	$r = 0.711$	< 0.001
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.478$	0.008
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.466$	0.009
Module 14	8 - 'How would you rate your comfort level at this point with accessing the Internet?'	$\rho = 0.461$	0.010
Student tracking	Number of visits to the course homepage	$r = 0.442$	0.015
First questionnaire	'How would you rate your current proficiency in using computers?'	$\rho = 0.425$	0.019
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	$\rho = 0.420$	0.021
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	$\rho = 0.373$	0.043

Table 83. Significant Correlations and Levels of Significance between the Total Number of Forum Articles Read and Other Variables (Ordered by Level of Significance).

Table 84 shows 10 significant correlations with other variables: the highest correlation found in this thesis research is between the number of posted articles and the number of follow-up articles posted to the forums. Those students who were sending more articles regularly posted more responses to others' articles in the forums. Correlations with comfort levels are also significant with word processing, posting to the

forums, and sending e-mail. Two other interesting correlations were with the number of quarters enrolled, with senior NPS students posting less articles, and with final grades – students more active in posting to the forums tended to get higher final grades.

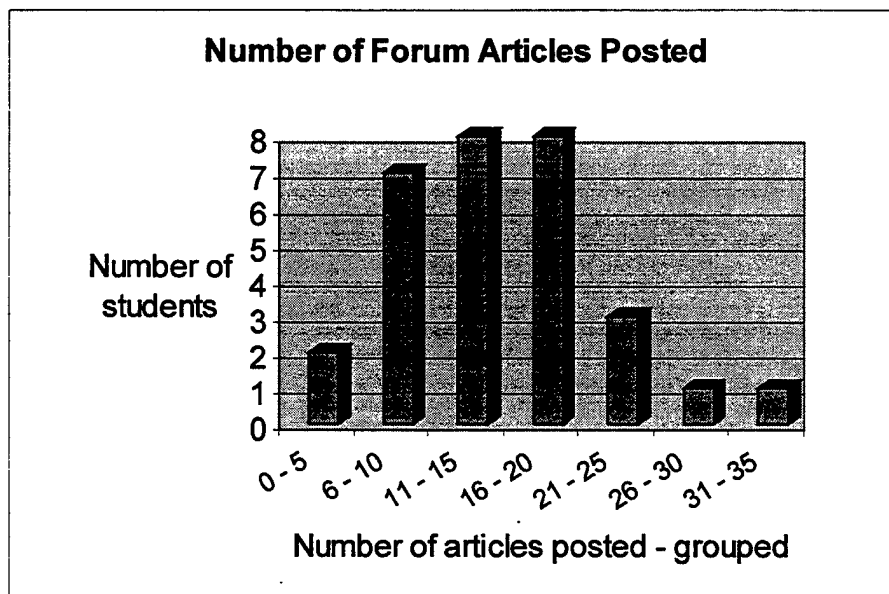


Figure 87. Distribution of Forum Articles Posted.

N = 30

Mean = 14.53

Minimum = 1

Maximum = 31

Standard dev. = 7.11

Instrument	Variable / Question	ρ / r	P value
Student tracking	Number of follow-up posts to the forums.	$r = 0.942$	< 0.001
Student tracking	Number of original posts to the forums.	$r = 0.656$	< 0.001
Student tracking	Number of visits to the course homepage.	$r = 0.508$	0.004
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.501$	0.005
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.497$	0.005
First quest.	Number of quarters enrolled	$r = -0.432$	0.017
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	$\rho = 0.416$	0.022
Module 14	3 - 'Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems.'	$\rho = 0.404$	0.027
Module 14	9 - 'How would you rate your comfort level at this point with sending electronic mail?'	$\rho = 0.398$	0.030
	FINAL GRADE	$r = 0.387$	0.035

Table 84. Significant Correlations and Levels of Significance between the Total Number of Forum Articles Posted and Other Variables (Ordered by Level of Significance).

The next indicator compared the number of original posts with follow-up posts. Follow-up posts are forum articles written as reactions to posts/articles written by other students or the instructor, what is graphically visible in the forums. Figure 88 shows the distribution. Most students (twenty-five or 83.33%) posted four to fifteen follow-up posts. Three students (10%) posted three such posts or less, and two students (6.67%) posted over 20 follow-up posts.

Table 85 shows significant correlations. There are seven of them. This variable correlates with final grades to a higher degree than the overall number of posts to the forums. Also, the correlation between the total number of posts and follow-up posts is higher than between the total number of posts and original posts. The conclusion derived

from these relationships is that the instructor valued originality in the student posting forums, what had an impact on student final grades. Three correlations with comfort level scales from the Module 14 questionnaires were statistically significant.

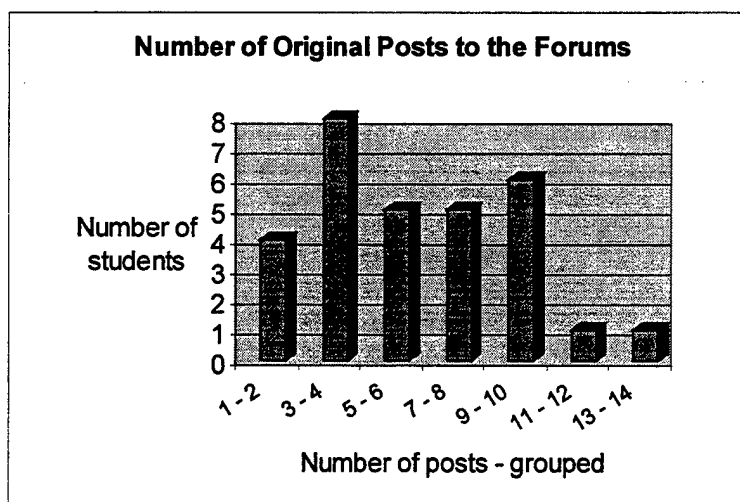


Figure 88. Distribution of Original Posts to the Forums.

N = 30

Mean = 6.13

Minimum = 1

Maximum = 13

Standard dev. = 13.17

Instrument	Variable / Question	ρ / r	P value
Student tracking	Number of articles posted to the forums.	$r = 0.655$	< 0.001
Student tracking	Number of visits to the course homepage.	$r = 0.619$	< 0.001
	FINAL GRADE	$r = 0.509$	0.004
Module 14	10 - 'How would you rate your comfort level at this point with posting comments to the Forums?'	$\rho = 0.485$	0.007
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.427$	0.019
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.412$	0.024
Student tracking	Number of follow-up posts to the forums	$r = 0.378$	0.040

Table 85. Significant Correlations and Levels of Significance between the Total Number of Original Articles Posted to the Forums and Other Variables (Ordered by Level of Significance).

As already mentioned above, the next variable, the number of follow-up posts to the forums (Figure 89) very highly correlates with the total number of forum posts. This variable also correlates with the final grades (compare Table 85 to Table 84).

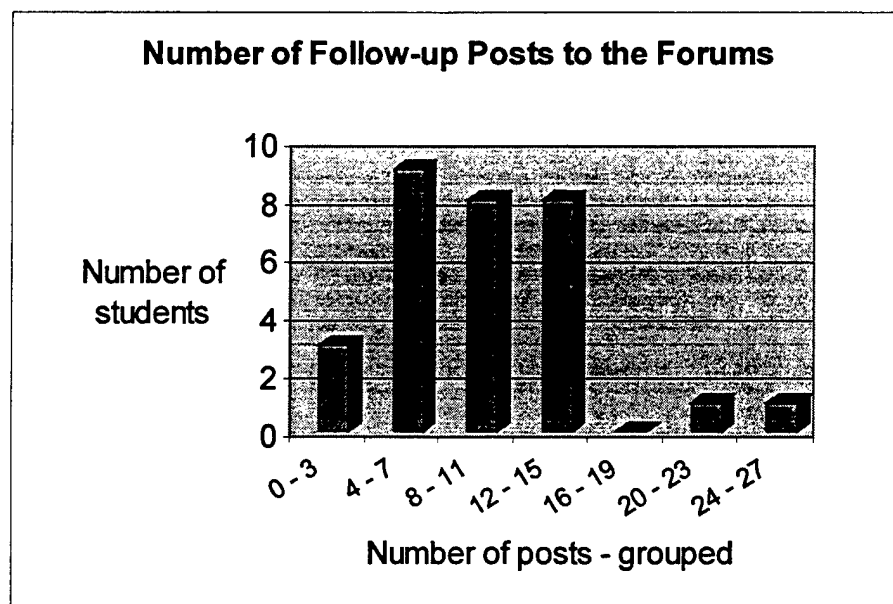


Figure 89. Distribution of Follow-up Posts to the Forums.

N = 30

Mean = 9.37

Minimum = 0

Maximum = 26

Standard dev. = 2.14

Instrument	Variable / Question	ρ / r	p value
Student tracking	Number of follow-up posts to the forums	$r = 0.942$	< 0.001
Module 14	3 - 'Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems.'	$\rho = 0.414$	0.023
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.414$	0.024
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.407$	0.026
First questionnaire	Number of quarters enrolled.	$r = -0.388$	0.034
	FINAL GRADE	$r = 0.379$	0.039
Student tracking	Number of original posts to the forums.	$r = 0.378$	0.040
Module 14	1 - 'Identifying key elements of Space Control.'	$\rho = 0.367$	0.046

Table 86. Significant Correlations and Levels of Significance between the Total Number of Follow-up Posts to the Forums and Other Variables (Ordered by Level of Significance).

The number of different pages visited was the last of the student tracking indicators (Figure 90). Most students (twenty-two or 73.33%) accessed all the available pages, but some visited fewer pages: five students (16.67%) visited 14 to 15 pages; one (3.33%) visited between 12 and 13, one between 10 and 11, and one only eight web pages. There were only four significant correlations (Table 87), but one of them is with final grades. Also, self-perceived skills in on-line searching correlate significantly with this variable: students with better on-line searching skills found all the relevant course pages easier.

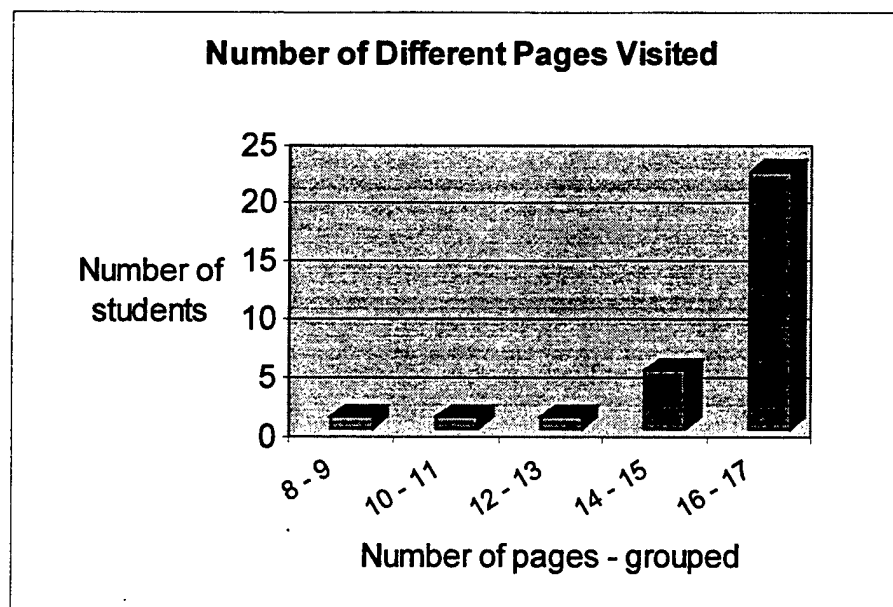


Figure 90. Distribution of Numbers of Different Course Pages Visited.

N = 30

Mean = 15.8

Minimum = 8

Maximum = 17

Standard dev. = 2.14

Instrument	Variable / Question	ρ / r	p value
Student tracking	Number of visits to the course content page.	$r = 0.716$	< 0.001
	FINAL GRADE	$r = 0.514$	0.004
Student tracking	Total number of hits.	$r = 0.395$	0.010
First questionnaire	'How would you rate your on-line search resources and techniques?'	$\rho = -0.404$	0.027

Table 87. Significant Correlations and Levels of Significance between the Total Number of Different Number of Pages Visited and Other Variables (Ordered by Level of Significance).

Besides all the listed data from the automated student on-line tracking, I also used data on the date and time of all posts in all forums to calculate the number of postings by by time during the day, and by day in a week (Figures 91 and 92). This data provides additional indicators of students' on-line activities that could help understanding the overall on-line dynamics within the course.

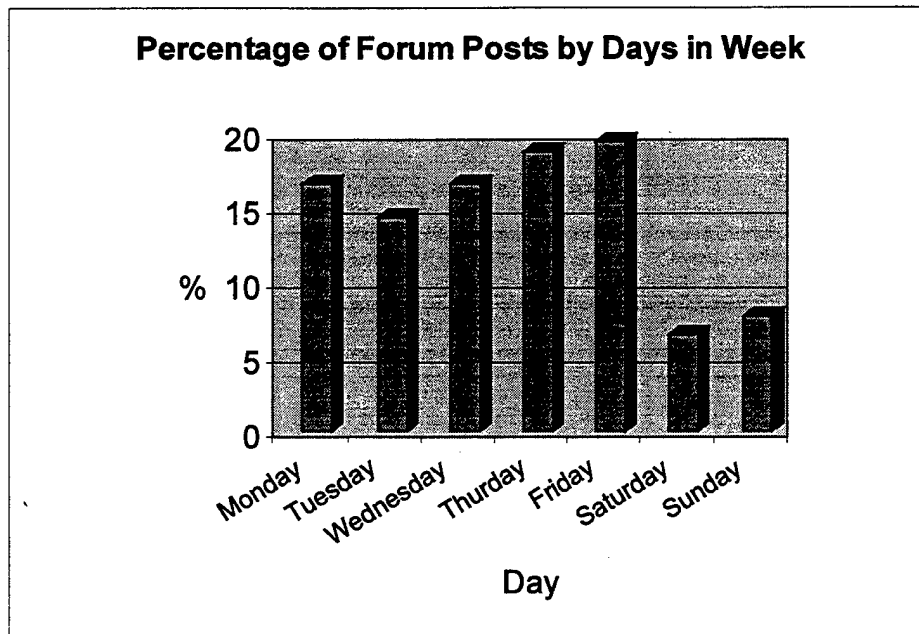


Figure 91. Distribution of the Posts by Days in the Week (in Percent)¹⁸.

The regular time to switch to new modules during the course was on Thursdays. Figure 91 suggests that the peak of student forum postings were on Thursdays and around Thursdays. Thursday was a usual day in a week when the instructor would make a new module available to the students and expect all assignment from the previous module to be completed. Another weekly peak was on Mondays. Students used the convenience of the DL course by posting comments on Saturdays and Sundays.

Figure 92 shows the average number of forums posts by time of day for all students and others who participated in the course forums. A 24-hour period is divided into 12 two-hours parts. There are three peaks of forum posting: from 9AM to 1PM, from 3PM to 5PM, and from 9PM to 11PM. By far, the fewest number of posts were sent between 1AM and 5AM. Rarely did registered course students access the on-line course

¹⁸ Note: this distribution includes all posts to the course forums, what mean not only those by students, but by the instructor, technical support staff and others.

materials from another time zone. Therefore, this distribution very realistically illustrates the circadian¹⁹ aspect of this DL course: NPS students in the sample were active from morning to late evening, without indications in this data set that they often take an 'afternoon nap'. Moreover, one of peaks of their activity was very late, between 9 and 11 PM.

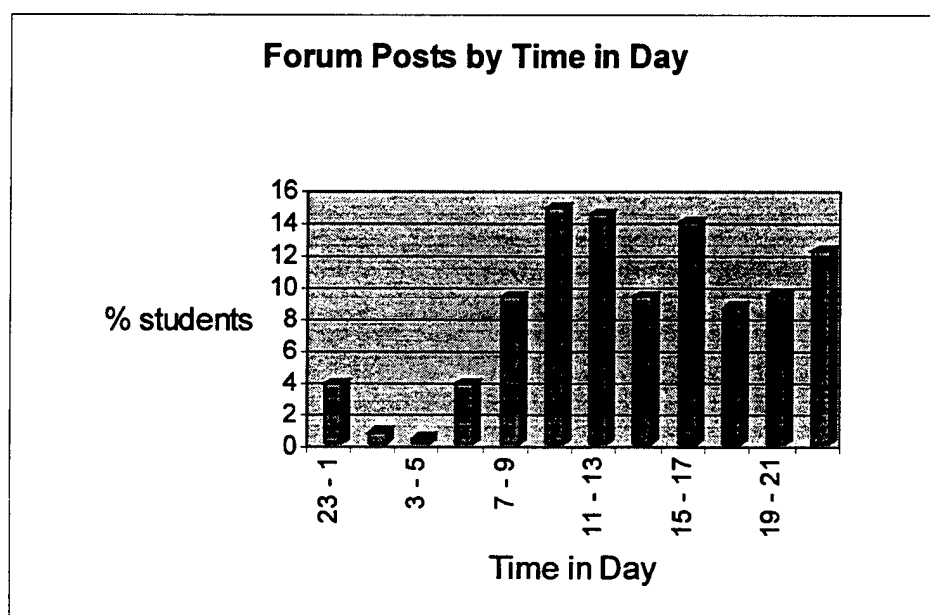


Figure 92. Distribution of the Forum Posts by Time of Day (in percent)²⁰.

Student Tracking - Summary

All eight on-line student tracking indicators appeared to be relevant to this thesis. They all correlated significantly with between three and eleven other variables from the First questionnaire (number of quarters enrolled), the Module 14 questionnaire (comfort level in on-line activities and in features used in the course) or with final grades (what makes them relevant as secondary indicators of student achievement). With some

¹⁹ There are numerous studies about circadian nature of human activities, for instance individual characteristics related with work in day or night shifts.

²⁰ Same remark holds for this distribution.

methodological reserve, all of them have notable correlations with final grades. Analysis of their mutual correlations resulted on several conclusions. For instance, the instructor valued, in terms of final grades, originality in the student postings to the forums more than reactive postings.

Also, almost all of the student tracking indicators, except two, had between two and five significant correlations with comfort level questions in the Module 14 instrument: comfort with the quiz feature, posting to forums, accessing the Internet, sending e-mail, and word processing.

Additional insight into the distribution of the forum postings by day of week and by time of day illustrated the convenience and time flexibility the students had in participating in the forums.

D. FINAL GRADES

Final grades were also available for this research. To convert them into numerical variables, I assigned points to the grades according to NPS norm: 4.0 points to A, 3.7 points to A-, 3.3 points to B+, etc. Figure 93 shows the distribution of the final grades.

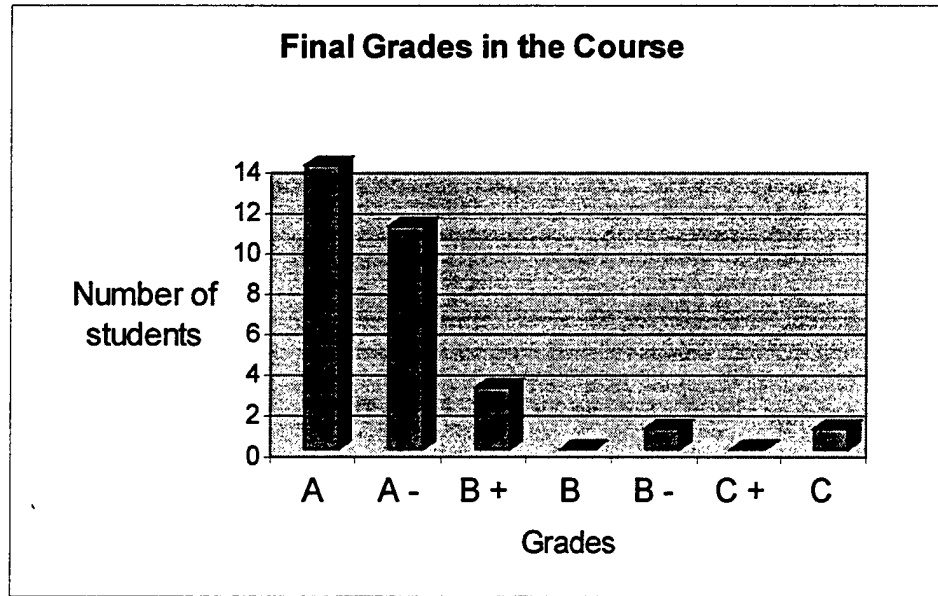


Figure 93. Distribution of the Final Grades in the Course (Grades Converted to Points: A = 4, A- = 3.7, B+ = 3.3, B = 3.0...).

N = 30

Mean = 3.71

Minimum = 2.1

Maximum = 4

Standard dev. = 0.43

Before listing the significant correlations this important variable had with other variables, I have to add an important methodological explanation: some of variables correlating significantly with final grades are numerical, so that Pearson's r coefficient of correlation could be calculated. However, because the grades are distributed very differently from a normal distribution and because of the small sample size, in these cases I also provide ρ coefficients also. The validity of the coefficients of rank correlation does not depend on the distribution or on the size of a sample, so it is advisable to use it in this case. Correlations are listed in Table 88. Note, however, that in cases when r or ρ for a numerical variable (student tracking) is not in the table, it means that it is not statistically significant (p is greater than 5%).

Instrument	Variable / Question	ρ / r	p value
Student tracking	Number of different pages visited.	$r = 0.702$	< 0.001
Student tracking	Number or original posts to the forums.	$r = 0.509$	0.004
		$\rho = 0.560$	0.001
Student tracking	Number of articles posted to the forums.	$r = 0.508$	0.004
		$\rho = 0.591$	0.001
Student tracking	Number of visits to the course homepage.	$r = 0.507$	0.004
		$\rho = 0.398$	0.030
Student tracking	Total number of hits.	$\rho = 0.448$	0.013
Student tracking	Number of the forum articles read.	$\rho = 0.441$	0.015
Module 14	11 - 'How would you rate your comfort level at this point with quiz feature being used to teach this course?'	$\rho = 0.465$	0.017
Student tracking	Number of visits to the course content page.	$r = 0.405$	0.025
Student tracking	Number of follow-up posts to the forums.	$r = 0.379$	0.039
		$\rho = 0.446$	0.013
Module 14	13 - 'How would you rate your comfort level at this point with word processing?'	$\rho = 0.395$	0.046

Table 88. Significant Correlations and Levels of Significance between the Final Course Grades and Other Variables (Ordered by Level of Significance).

Final Grades - Summary

Final grades significantly correlated with ten variables: with eight online tracking indicators (i.e., all of them used in this research), and with two measures of comfort level (with the quiz feature and with the word processing). The correlations do not show causality, but they describe relations between sets of collected data. On the other hand, this is confirmation that on-line tracking indicators are relevant for the research questions in this thesis and can be used as important indicators of several factors in a DL course in further studies.

E. INTERVIEWS WITH THE STUDENTS

Seventeen out of thirty students agreed to give interviews.

The instructor thought that only students with very good course grades would agree to the interviews. Statistics support that expectation. From seventeen volunteers, nine had A and eight A- as a final grade. However, I wouldn't say that only the best students volunteered, but rather that the students with some problems in the course (those with the grades below A-) did not volunteer to participate. More than likely, this sample of seventeen students is self-selected.

Interviews were conducted in the quiet part of the Dudley Knox Library at NPS. Only the interviewer made notes. At the beginning of each interview, the interviewer explained the purpose of the interviews, emphasized that all responses would be used only for the research, and stated that the identity of any student would not be revealed in the thesis. Most interviews in average lasted between fifteen and twenty minutes.

In next eleven subsections I present student responses in sequence of the questions, grouped by their main meaning.

1. First Question

The first question was: 'In general, could you estimate have you learned more from the on-line designed course than you would learn from a face-to-face SS3011 course? I'm asking you about the successful learning of the subject matter taught through distributed learning, not about a particular instructor or anything else.' There were not any questions similar to this one in the four applied on-line questionnaires or in the SOFs.

Here are their full responses, grouped into three main types:

No

- Clearly no. Learned lot of basic things, but question-answer dialogue is not good.
- Probably not. Something is missing - interaction.
- Somewhat less. It was his²¹ personal fault - lack of motivation to learn. All information was available, but he was short on time. It is different when one hears something in a classroom - it sounds more serious.
- Definitely not more. It was hard to read everything. Main text has to be read, and then one usually waits for a couple of days and read the comments. He had a problem because he likes to have 'duty expert' available. The advantages of the DL would be large if he were somewhere on duty, not in the school.
- No, but he got what he needed. It's matter of student mind set; it's competing. It's overview of space tech; he got what he wanted. If a course were more oriented to his future job, he would give more efforts.
- Clearly no. He perceives face-to-face instruction as more challenging, more demanding, and it is giving more options in what and how to learn.
- Clearly no. He was exposed to more material, but it was not integrated.
- Clearly no. It is not possible to throw into DL course all information from a face-to-face course and expect it will function. It all has to be reconstructed. There was much information in the course (books, all those modules and links). He was missing prioritization, i.e. selection of information.
- He learned less. It's about self-discipline. Students were not forced to read it all, so it was easy losing time.
- He would probably learn more in face-to-face class.
- Clearly no. Students did what they had to do. She is personally not very interested for this subject area. In a face-to-face course, she would probably learn approximately the same or little bit more, what depends on instructor.

Same or undecided

- Equal, not more or less. Organization was different, easier, but equal results.
- It's hard to measure that. Equally, readings are giving lot of learning. It's difficult with materials you don't understand and instructor has to explain - this was lacking in the course.

²¹ I.e. it was the fault of this student who gave the response.

- Same.
- He learned approximately the same; either way offers enough opportunities. Maybe less interaction with the instructor, and overview class was not very deep, but it was very good - because this course was an introduction to the area.

More

- She probably learned more from the Internet version. Content was more interesting, broader pool of resources. Excellent instructor's job. She helped in learning process. It depends on instructor. Interaction was better too. She personally likes to express her opinion in calm environment, this suited to her.
- Not in all areas, but in some he learned a lot more, especially about own learning style and similar personal learning characteristics. He likes to discuss, but he was limiting his posted comments only to few sentences. He learned a lot from 3D graphics and from links. He learned very much in visual sense, but not so much in subject matter.

First Question - Summary

Overall, their responses may be summarized as: 'no' – eleven students; 'same' – four students; 'yes' – two students. Qualitatively analyzing the messages in the 'no' responses, I found three key elements that students thought caused the on-line course to be less effective than a face-to-face course:

- **The course content and design** (explanations: it wasn't integrated; dialogue can't replace full personal communication; missing selection of information; DL course can't work as face-to-face course).
- **Students and their motivation** (personal fault; missing competition or challenge).
- **Environment** (it would work better from a duty than within the school).

I found more difficult to interpret student responses in the 'same' group. As the main justification for their responses, the students reported that though on-line and face-to-face courses have a **different organization** of a learning process (with different

amount of interaction), the learning **results (effectiveness) are equal**. They thought there were **enough learning opportunities** either way.

Two students responded they learned more from the on-line version of the course. One of them was very positive about the on-line course, another only partially. Both mentioned terms like 'learning process' or 'learning style', and emphasized control over their interactions with the others, which they considered as an important and desirable factor for their opinion about the course.

2. Second Question

The second question addressed forums: "Students' answers about forums were very different, as to whether forum exercises were useful in helping students understand the subject matter. What is your final opinion about their real usefulness in facilitating your learning? Also, comment on how much you liked using forums."

Here are the student responses:

Not useful

- He didn't like them. They were too time-consuming: sit, read everything, scroll... Some were useful, some less useful, there was too much writing. It is easier when the students worked in small groups; otherwise it's too difficult to control it. Personally he prefers face-to-face discussions, even by VTC once a month.
- He didn't like forums; didn't learn much from them. Most of them were too focused on some issues, what was not very productive. Instructor wasn't able to moderate the forums well, to encourage and direct/guide the discussions.

Probably useful

- Forums seem to be effective, useful interaction tool, but there is a drawback – it's more opinion oriented than factual learning-based. People have different background and opinions; it was useful to see that difference, but he is not sure how useful that was for learning. If you post a comment without reading other posts, all readers can see you were not prepared.

Useful

- It would be more useful in more advanced class. Good in sense of applying the learned about space systems, but most of material was brand new to the students. Interesting, but people often didn't know what to say, tended to go off subject.
- She liked them. Useful, good references, it's possible to go back to them. People normally oppose the change in way they work/function as students. The course was well organized; contained lot of thoughts.
- It was useful for learning. He liked forums. Timing was wrong in this type of audience, in context of NPS: it should be Monday-Friday.
- It was more useful in small groups; he liked that. However, the instructor was the expert, not the students, so it seemed that real knowledge wasn't 'part of the game'. It was based more as 'opinion section', not factually based materials.
- With the given limitations of on-line systems, forums were useful. People have different backgrounds and opinions, what he²² likes and thinks that was very useful. There were some problems here and there; posts should be limited by length.
- Yes, useful, he got majority of what he gained in the course from reading forum messages, even though it was not much a direct learning. He enjoyed them, liked them. He learned mostly from texts.
- Beneficial, even more after dividing the class into smaller groups. It takes time, but this is closest to classroom interaction you can get. He liked forums.
- Useful. He recommended division of forums into smaller groups, what the instructor did later. Many students posted because of grades; they knew it was expected of them. Some had excellent ideas, but they wrote too much. Instructor should be more specific about topics of the forums and should limit the length of posts. Many thoughts are being repeated. Maybe forums should be made only for some of the modules.
- He liked them - he heard different opinions, everybody thought differently. When they were easy for use and functional - it was very good. When there were technical problems with posting to forums, there was no use of them.
- Yes, they were useful, one of the highlights of the course. He liked them. Some people were very active in forums, have written a lot.

²² He – the interviewed student.

- She liked them. They were useful. They forced students not to just react, but to form an opinion and to ask for more explanations. Some people are not comfortable speaking in class, but in forums they gave more, they participated more. Forums helped to get together more different opinions and to explore different opinions. It was different than class environment.
- Yes, useful, but he didn't like them. Some students had excess time - they wrote very much. He wrote brief texts. He didn't like lack of responsiveness in the forums.

Very useful

- She liked them. Open dialogue, and people more forthcoming with their opinions. She would prefer chat (real time) as addition. Very useful, especially towards the end. All in all, very well rounded opinion.
- He saw forums as very useful; lot of reading involved, challenging because one has to be careful what to write. Weakness is that you should read all previous postings. There was no way to search all posted information; it would be a very useful capability, way to cataloguing posts. Personally, he works a lot on development of web applications.

Second Question - Summary

If we reduce the student responses to this question in the interviews to key messages/responses, they would be: 'not useful' – two responses; 'probably useful' – one response; useful – 12 responses; and 'very useful' – two responses. Analysis of the responses suggests that the students used the same argument about **student opinions** to support quite opposite responses. Here are the factors they emphasized for their responses to this question:

Responses 'not useful'

- Not much to learn because posts are **opinion-driven**, too focused, not factual'.
- Too time consuming.

Responses 'useful'

- Diverse, **opinion-driven** and background-diverse posts. (Five responses.)

- Post can serve as good references.
- Forums acted as replacement for class interaction.
- Forums help some students, otherwise very quiet, to express more freely.
- Posts more discuss applications than theoretical aspects of the space systems issues.

Response ‘probably useful’

- Dilemma (or drawback): forums may be useful or not because they are **opinion-driven**.

Responses ‘very useful’

- Students are forthcoming with their **opinions** – open dialogue.

3. Third Question

The third question addressed quizzes: ‘Same question about Quizzes - please comment on how useful they were for you and how much you liked them!’

Here are the responses to the third question:

Not useful

- Not useful. They didn’t have enough depth. It was possible to answer by reading from the textbook. He didn’t like them.
- Absolutely not useful. Too easy, they²³ could do five runs, with the book.²⁴ They did not demand students to think. She didn’t mind doing them. Maybe some essay-type questions could be added, especially in second half of the course.

Not very useful

- Not very useful. They were never completely fixed. They were easy, but one had to read the book. They should be more challenging.

²³ The students.

²⁴ Quizzes provided students with feedback about incorrectly answered questions, and enabled them to go through all questions up to five times. Because quizzes were on-line, it was possible for students to use the textbook and notes while answering quiz questions.

- Not very useful. It was more like a test have you read the material at all, than anything else. It would be better if quizzes were directed towards some knowledge test at the end of the course.
- If open book and more than one pass, not much use.
- They seemed pointless; they didn't capture students' understanding of subject.
- It was just a drill, not very useful: open book, no restrictions, almost anyone with the book could do to them.
- He liked them in sense of not demanding too much, but the facts from quizzes didn't remain in knowledge; in essence it had not much use.

Useful

- Good as a review process. Open-book so student could choose not to really learn about topics from quizzes but simply to read from the book. Problems with grading were very frustrating. It was too easy, but good subject matter issues were present in content of the quizzes. The quizzes were too simple.
- Yes, useful, forcing you to read. That was the point. Easy.
- They were not difficult; he liked them because they contained information and facts, not opinions.
- Yes, useful, forcing students to do the reading. For DL (web), self-discipline is very important. Quizzes were pretty relevant. Otherwise it would be difficult for a student to identify where he stands, what he has to do. They were definitely a roadmap of the course, important feedback.
- Yes, they were useful, but not fair in sense that they can be answered in collaboration with other students. They should be more challenging, but they were not too easy. He neither likes nor dislikes quizzes.
- Useful, they let students know what they should have learned. Make students to HAVE to read/learn material. He didn't like them much; he's neutral. To have several runs in a quiz is counterproductive. Quizzes didn't demand true understanding from the students.
- Quizzes were appropriate. They help to focus study, help to understand what's important, what you needed to learn. They do not need to be difficult to do that. He liked them.
- They were too easy. There were some technical problems at the beginning. It is good that more runs are possible in quizzes, but then their usefulness (and fairness) becomes questionable. The quizzes should be a little deeper, more comprehensive. Maybe only two tries, not five. Also, maybe few essay-type questions should be added.

- They were tied closely to the book, without them students wouldn't read as much. Quizzes were good, forces you to learn but not too hard. Helpful - forced students to self-organize.
- He liked quizzes and there should be more of them; otherwise he would study too much in last minute. He liked the possibility of redoing the quiz. They are useful for the learning process. Bugs made some of the students angry. Quizzes were 'confidence builders'; they were balanced mixture of course content, some maybe even too condensed.

Third Question - Summary

Summarized, student responses were: 'not useful' – two responses; 'not very useful' – four responses; unclear – one response; 'useful' – ten responses. After analyzing these responses, I concluded that the key reason for such opposite views about the quizzes was **different interpretation of the role of the quizzes**. For instance, both groups of students who saw the quizzes as either not useful or as useful mentioned that they were easy. However, they saw role of quizzes in the course completely differently. Also, some students **thought the quizzes were easy but did not like them**. These students were used to competitive, demanding, and challenging tests, quizzes, and exams. Consequently, these quizzes (with five possible tries and with no time or closed-book constraints) were not challenging them. In fact, quizzes that are too easy may seem offensive to them.

4. Fourth Question

The fourth through seventh question covered issues of interactivity. The statements asked the students to comment the amount or quality of the interaction between the students and the instructor or between the students.

The fourth question was: "Students' answers to the question about how they saw the **amount of interaction with the instructor** during the SS3011 course, compared to a similar resident (face-to-face) course, were very different. Please provide your view."

Here are the responses to fourth question:

Much less

- Much less interaction. She felt depersonalization. The instructor didn't know some of the students. Not much one-to-one interaction.
- A lot was lost. No body language. It was time consuming, but the students lost important part of communication.
- Much less interaction in on-line than students needed. The instructor worked hard 'behind the curtain'. At the beginning the instructor posted many comments, but later less - it was lacking.
- Much less. (Two responses).
- Much less amount. Personally he likes to talk a lot, to personally ask the instructor. His interaction was clearly less.

Less

- Not enough, maybe the instructor wanted to be 'invisible' too much.
- It was less, but it wasn't so bad. It's simply different environment (for the students).
- Significantly less.
- Less. There is no personal interaction like in a classroom, but the instructor can better focus the interaction he/she has, and to use it more efficiently.
- The problem was that DL course was organized in local environment. If students had to take written materials from the instructor, then DL loses its sense. The instructor was giving her best, responded to all e-mail messages, talked a lot, and that was very good. The amount (of interaction of students with the instructor) was a little less.
- Less.
- Less. Most of interaction in forums was about technical problems. The instructor pretty often participated in the forums, mostly in form of response to one person's post.
- Not enough.

Unclear

- It is an individual interaction with the instructor. In face-to-face courses, students rarely exchange e-mail with instructors. That was the good side of on-line version of this course.

Enough

- There was enough interaction; it was possible to contact the instructor anytime, or other students.

More

- In fact, there was MORE interaction. He had another on-line course, very structured, without almost any interaction with the instructor. In SS3011, the instructor was very dynamic, stimulative, responsive, and she was key factor for the success of the course.

Fourth Question - Summary

Reponses may be summarized as following: 'much less' – six comments; 'less' – eight comments; unclear – one comment; 'enough' – one comment; 'more' – one comment. Analyzing the 'much less' responses, I concluded that those students felt uncomfortable because of the absence of the **instructor's personal presence**. They mentioned terms like 'body language', 'depersonalization', and similar terms without any other clear justifications for such responses. The student who responded 'more' in fact was comparing this course to another on-line course, but with much less interactivity. Other students gave a wide spectrum of explanations. It seems that their approach to DL interactivity was more diverse than approach of the students who responded 'much less'.

5. Fifth Question

The next statement was: 'I want to ask you similar question about the **quality of students' interaction with the instructor**, compared to a resident course. How did you see it?'

Here are full responses of the students to fifth question:

Less

- It decreases if it's only all in words. With multimedia and similar improvements, it's better, but there are more lost aspects. Very time consuming. It's much better in small groups, more personable.
- Usually someone's opinion can be understood better if you're facing that person. Otherwise, that is lost. The instructor wasn't present enough. She²⁵ 'intervened more after the fact' than she was engaged.
- It depends on instructor. If the instructor is active, reactive, responsive, then it's OK. Maybe little bit lower quality than in face-to-face course.
- Clearly less effective. Instructor was relatively OK, trying to be involved as much as possible. IW²⁶ class – the students barely heard from the instructor at all, that was hands-off process.
- Nothing can really replace face-to-face, even though the instructor was very responsive. He felt the need to talk to her.

Unclear

- The instructor was very good; she was able to answer every question, what increases quality. However, she didn't force all students to enter into interaction with her. Deeper integration is missing, nonverbal communication not present.
- That's tough to achieve. The instructor was very responsive, but maybe not enough for him personally. He felt something was missing to conclude each of the modules, maybe real-time on-line (chat) session about it, or at least the instructor sending some kind of conclusion to each student (some 'walk-away' points).

Same

- Probably the same as in face-to-face. The students had possibility to visit personally or contact by phone the instructor, so they were able to increase quantity and quality of this interaction if they needed to.

Good

²⁵ The instructor.

²⁶ Information warfare.

- The class was too large. Instructor didn't have enough time. Quality was good.
- Good quality. The instructor's comments were good, relevant.
- It was better than in face-to-face; it was individual feedback.
- Interaction with the instructor was mostly by e-mail, but it was good. Whenever he personally met instructor, interaction immediately started. There were no occasions when the instructor didn't respond.
- The quality was pretty good. However, responses from the instructor should be quicker.
- It was fine; the instructor was sending comments throughout, but it's limited.
- It was good. The instructor was responsive, though not quite enough. For him personally, face-to-face is 'better quality' because of his learning style. In face-to-face class, stupid question is quickly forgotten, but in DL it stays on server. In terms of contacting with people from space systems practice, nothing is good as DL.

Better

- The quality is better. There is always an option to initiate more interaction if you need it. There is a potential here for much more interaction (like in face-to-face), but it's not really as necessary.
- Not diminished, maybe even better. She²⁷ had problems with the password (SSN). The instructor was doing her best. She was very responsive.

Fifth Question - Summary

Summarized, the responses were: 'less' – five responses; unclear – three responses; 'good' – seven responses; 'better' – two responses. Explaining the 'less' responses (there were five such opinions), students emphasized the lack of the instructor's personal presence, which was also similar to the explanations for the 'much less' responses. Ten students thought that the quality of the interaction was good, the same, or even better than in the face-to-face class. Even though many of these ten students mentioned other problems such as too large a class, problems with passwords,

²⁷ The student.

the instructor's responses was not quick enough, personal preference with face-to-face classes, they still saw the quality of the interaction better anyway.

6. Sixth Question

The sixth question asked: 'One of most controversial questions, according to the students' answers, was about the **amount of interaction between the students**, compared to a face-to-face course. Some thought SS3011 offered significantly less interaction, some others - significantly more. What's your comment?'

The complete responses to sixth question were:

Much less

- Much less interaction than in face-to-face courses. Majority of interaction was between the students. Most of interaction about the course in the on-line mode was about the course itself, not about topics.
- Much less - he met almost nobody, only one
- Very low amount

Less

- For majority of students it was purely on-line. Amount is limited.
- Significantly less than in face-to-face course. He was thinking a lot about applicability of this knowledge, he was expecting a 'toolbox' from the course. Students talked about that a lot.
- Less than in normal class. Tempo was fragmented; many were working only once a week. There were many postings; it was expected from the students. The quantity was not at the same level as quality.
- Forums were there for this interaction. Of course it was different than in a classroom (face-to-face). Less interaction.
- Besides forums, not much interaction. DL form decreased interaction.

Little less

- Probably little less because there was less informal interaction which usually goes in a classroom. He didn't have any informal communication. Somewhat less than in face-to-face course.

- Not so bad. He felt good and bad sides that; maybe bad sides a little bit more. If he were on duty, on a ship or something like that, it would be OK! Here in school occasionally it was frustrating. It even happened that students were sitting one next to the other and they were exchanging e-mail!
- Maybe the same or little bit less. If students sit together in a classroom, of course they exchange more information.

Same and unclear

- Purely within the forums (at least for her). Pretty good interaction. Everybody can respond to everybody. On-line delivery increased quality and quantity of interaction between the students.
- About the same. Students in NPS talked at other classes too. Mostly, it was OK.

More

- The difference in interaction was almost unfair. There was a lot of interaction, because the students were forced to respond to posts.
- There was more interaction here; in face-to-face courses every student is concentrated on the instructor. SS3011 students were with different backgrounds, but exposed to the same material and they became closer. Maybe the instructor didn't mediate enough; she ought to direct more attention towards the key points.
- More, because it was required to post responses and thoughts. In usual classroom there are always some students who do not talk much. Here all students were forced to participate, so there is more interaction than in face-to-face class. Good quality and quantity of interaction between the students, but for a high price (again, he personally prefers 'face-to-face'). He simply doesn't like to write.

Sixth Question - Summary

I grouped student responses by their key messages as follows: 'much less' – three responses; 'less' – five responses; 'little less' – three responses; 'same' or unclear – two responses; 'more' – three responses. Interestingly, there was a broad spectrum of different answers to this question. Most students (eleven out of seventeen), thought that there was interaction between the DL students compared to a face-to-face course. It is

very difficult to interpret this data, but it seems that these student subgroups with different opinion might have a different focus in face-to-face classes: one focused their attention more on the course instructor, and the other more on the teaching material in the course. If so, their perception of the change of interactivity in the DL environment might be so opposite, as it was in the example of the responses to this statement.

7. **Seventh Question**

The next question asked: 'The last question about interaction covers the issue of quality of interaction between the students, what is important for the learning process.²⁸ How would you comment it, in sense of comparing the **quality of interaction between students** in on-line SS3011 with interaction between students in some similar face-to-face course?'

Here is how the students responded to seventh question:

Worse

- Worse, same answer as in question 6. Synergy never develops.
- The quality was suffering, but it wasn't because of the instructor but because of media used (DL).
- The interaction quality was not as good as in a face-to-face course. Limited, time-constrained. No real-time interaction. The best sort of learning interactivity is arguing in class.

Same or unclear

- Fair, in the middle of the scale (2.5/5). Before the end of the course he understood the instructor's expectations/demands, but that can't be done mechanically, a dialogue is necessary. When one starts to feel that he isn't getting anything more from new postings, then there is no more need to be engaged in that dialogue. At one moment, it isn't stimulative any more. Time factor is very important

²⁸ Research and experiences with DL at UCF and the instructor's and student statements during this course agreed about the importance of interactivity for efficient learning in a DL course.

- It depends: some students thought well before posting an answer. Others went directly with their opinion, without many facts in the content.
- Forums were best part of interactivity in this course. They reflect that quality of interaction. Some students were expressing own opinions; others were reacting, or were not able to react if everything is already said.
- Some people have more difficulty talking in front of the others. Also, if on-line, one has to be careful what he is writing. It would be better if an instructor told to students to feel free to write their own opinion (with a level of privacy too!), and it would not be sent to anybody else, but she can't remember that the instructor in this course told anything like that.
- It was laborious. He would like more real-time discussion. There was quality, but maybe not in right format.

Little better

- Probably little higher quality, because one has to think well before posting message/ comment.

Better

- Pretty good quality. Casual interaction from face-to-face courses was lacking here.
- Pretty good
- Quality was better. One has to research what he wants to say – can't write too much. He personally used to revise his posts before sending.
- Academically, the quality was better. It was also good that posts remain as references. So one has to be careful what to post, have to check it in the book.
- It was hard, but probably better because of much written communication.
- Yes, better quality, but different kind of interaction. Personally he prefers not to write, so he was very careful in writing - that was a challenge for him.
- Probably higher quality. The instructor never directly commented on postings.
- He agrees that one should think before posting (it stays on server), but there are some students who posted (in forums) only because they had to. Quality was higher.

Seventh Question - Summary

Summarized, the student responses were: 'worse' – three responses; 'same' or unclear – five responses; 'little better' – one response; 'better' – eight responses. Clearly, when the question is about the quality of the interaction between the students in the DL environment, the students have significantly more positive than negative opinions, compared to the question on the amount of the same type of interaction. Nine students thought the quality of the interaction was better in DL than in a face-to-face course, and only three students thought the opposite. Several students stated that one of the key reasons for this opinion was the fact that posted forum articles are written material that stays on the server as a reference. Therefore, it is necessary to be careful about what is posted.

8. Eighth Question

The eighth question in the interviews was: 'If you have an opportunity to choose between on-line and face-to-face section of some other class in your curriculum, what would you do? (Examples: I would surely go online; depends on the nature of the course; depends on my schedule; surely stay in face-to-face section...).'

Their responses to eighth question, grouped, were:

Face-to-face

- While in NPS, preferably face-to-face, but not 100%. In some situation DL gives far better flexibility, but the quality is important issue too. Face-to-face has some big advantages. If he is in some degree education program, it depends; he would probably take it 100% on-line.
- Face to face, mostly. He has a face-to-face course that is perfect for on-line delivering.
- Clearly face-to-face, it fits better his learning style. He gains a lot from interactions than from quantity.
- In the school he would take face-to-face, but if out of the school, or taking only some single external course, he'd take on-line.

- In NPS - face-to-face. If on duty, of course or traveling who knows where - he would take on-line.

Depends

- It depends on type of a course. History or similar (one-way dialogue) - on-line is great. Math or similar courses demand interaction, so he would prefer face-to-face.
- Depends on the course. More complex, dynamic courses would be very hard on-line. More basic, core courses can be on-line. She had Information Warfare course on-line; they were conceptualized differently.
- It depends on the course. If something from history or political sciences, surely on-line. Math: face-to-face. SS3011 is somewhere in the middle. It suffered a little as on-line, and it depends much on depth of solving technical problems and similar issues. The course was more at a general level.
- Depends on the course. Math - face-to-face. This course - OK for on-line.
- It depends on: 1. Course. 2. Instructor (what he knows about instructor). 3. Time available. Example: now he has a course, which is all in Power Point format. Such course should be on-line, because course instructor is not necessary. SS3011: students and the instructor should meet at least once a week, even using VTC.
- Depends on the content. Some courses like history or social sciences are better on-line. Math and similar - better face-to-face.
- If course is similar to this one, he would take it on-line, because it gives a lot of flexibility. This is the main advantage. If something is more difficult, like math, he'd take it face-to-face.
- It depends on course material. More technical courses (math, engineering) - he would choose traditional classroom, because he is not as experienced in that area. He needs advantages of a face-to-face class.
- Depends on type of a course and on the environment (in the school or off school). In the school he would mostly choose a face-to-face section. If on job, he would clearly choose on-line, because of flexibility.
- Depends on instructor. Short courses (compressed into three days or so) should be taught via DL, but if three weeks or more - face-to-face. After some time interest decreases. If a course is not demanding, attention and interest diminish.
- Probably face-to-face, but it depends on the course. If something is not interesting to him, DL wouldn't help.

- It depends on the nature of a course. If it's required for a degree, but she is not particularly interested in that course, she would take it on-line. If it's one of more interrelated courses (math or similar), she would take it face-to-face, especially if she doesn't have background in that area. In any case, it's GOOD option!

Eighth Question - Summary

Of the seventeen students interviewed, five responded 'face-to-face' and twelve responded 'depends'. Only five students said they preferred the 'face-to-face' version of the courses, but even within that group, four students added that they would change their opinion if they were not at NPS.

The students who responded 'depends' gave three typical explanations of what 'depends' meant to them: on the environment (in a school or from duty), on the nature of a course (if a less mathematical or technical course – the student would more likely take the on-line version), and on an instructor.

9. Ninth Question

The ninth interview item asked students: 'Please tell us **any advice/recommendation/suggestion** you have for CDR Higgins or any other NPS or Navy distributed learning instructor.'

- Have to have face-to-face meetings every 14 days or so, if possible. Tech things should be fixed before the start of the course - students felt like subject of experiment.
- The instructor was very responsive, and that was good. Instructor has to be very involved, has to guide.
- He liked forums. However, a student has to be careful with time dedicated to the forums because of other courses. Quizzes shouldn't be too easy if they're on-line. Face-to-face quizzes are twice as difficult. There were some tech problems at the beginning. The instructor's feedback has to be sent to individual students or groups. CDR Higging made some observations about whole class, but nothing more than that.
- There must a backup plan, even a second backup for the course too.

- Advantage of DL is time (whenever you choose). So, entire course has to be ready and available in advance (or least, large parts of the course).
- On-line courses have to be non math-intensive or similar types of classes (with good textbook).
- It is the key to combine DL and face-to-face component in an ideal ratio. That ratio depends on a particular course in question. Also, when putting links on a page, instructor has to be aware of total amount of information.
- Closeout of the modules is important. He is visual type, so he would like to occasionally see somebody talk about the issues in the course, even via video-stream or something like that.
- On-line learning is good; it depends on subject matter. This course was really good. If there were more math, it would be too difficult. It depends on a course. It worked pretty well.
- It's important to capture well and to transform the knowledge into on-line content, but it's important to be able to transfer that to both instructor and the students. On-line learning misses sharing of who knows what on important issues. Information has to be customized. SS3011 was better in on-line form probably because the students were forced to read all material. Technology had to be prepared better.
- The instructor tried to get feedback from the students and was very opened to suggestions. The feedback is very useful for fixing the course problems. Right now there is no perfect course on-line. There should be more multimedia (applications, demos, interactive things), and some real-time chat, maybe even in voice transfer (some people are well spoken but can't write very well).
- Instructor should encourage students not to wait to the last moment (with studying). This course's web pages were predominantly text-oriented. He had another course with much more graphical materials on web pages. He thinks that more interactive and graphical content should be put on SS3011 pages too. He is indifferent about real-time chat option, that would be like imitation of real classroom and DL wouldn't gain much with it.
- Instructor should meet with students in a classroom from time to time, at least couple of times, maybe in a round-table forum or in small groups. Such modification would facilitate learning process. Another problem is that students do not see such course as high priority. List of all deliverables should be defined at the beginning of the course. That should be very useful.
- Do not teach DL the same way as face-to-face learning. Information has to be well structured.

- Maybe forums should be real-time or both. Maybe groups should be changing, and they should meet in real time. Personal self-dedication is a necessity.
- The course was OK. It would probably be more useful to a people outside of NPS - and it should involve more people. On-line section has to have meetings too, maybe 2-3, especially wrap-up discussion.
- The only complaint she has (what also holds for some face-to-face courses) is that she likes to see at the beginning what will be covered in whole course. This was not visible in SS3011. That was the largest problem for her. She expects to be self-paced and would like to have at least a complete reading list. There is also a timing issue in forums and there was some 'just in time' studying.
- He'd like more multimedia content, video stream and similar. It is very bad that many courses in NPS do not use any computer or Internet capabilities, 3D and similar!

Ninth Question - Summary

I reduced the student recommendations to their key messages to the instructor

(ranked by frequency):

- Fix all tech problems as soon as possible (three students).
- Organize occasional meetings with students, every 2 weeks or so (three students).
- Provide list of all deliverables/obligations at the beginning (two students).
- Introduce some real-time or combined chat/forums (two students).
- Give tougher quizzes.
- Provide more feedback from the instructor (to individuals and to groups).
- Develop a backup plan (in technical sense).
- Provide better module closeouts.
- Design more multimedia and graphical course content.
- Find a way to force students not to study 'just in time'.
- Involve external subject matter experts.

It was difficult to synthesize these categories of the student recommendations because some of the categories overlap. The recommendations address the following

issues: course web design – four responses; technical problems – four responses; communication between the students and the instructor – four responses; general organization of the course – three response. These are all very important elements in creating a positive learning environment for the course.

10. Tenth Question

The tenth question was: ‘This course was not only a space-systems course, but also a **new experience** for most of the students in this section. Looking at the course from this time distance and do you think you’ve **gained some other benefits besides the course objectives themselves**? Please comment.’

Here are the student comments to the tenth question:

No

- No, because most of students already had decent computer skills. Future IS going towards DL; EXPOSURE to it was main thing, kind of trial-and-error.
- He already knows everything about DL.
- Most of the students are good in IT²⁹.
- This was his first on-line course, but he works a lot on-line. Without that knowledge, it would be harder. So, he didn't gain anything new.
- He is very good in Web and PC technology, so he didn't gain anything else. Maybe only new personal experience, and he may do something similar in the future (he works in IT area).
- He had a plenty of on-line learning (10 courses) already.
- Probably not. This is connected with issue of PC proficiency and with experience with the Internet. He is very good in that, so he didn't gain anything else significant.

Only writing

- For him personally, only challenge is to write better. He gained nothing new in technical sense; he is very proficient in web technologies.

²⁹ Information Technology.

Yes

- It was very different from the other on-line course (IW) she had.
- She liked this way (of learning) and would like more. She has learned that there are more than one way for presenting information, and PLENTY of sources. The instructor did a great job.
- He learned a lot about forums. He had computer proficiency before.
- The course opened for him doors of new educational opportunities, and there are many (Net-G Navy program and other educational opportunities). He will certainly enter into such programs, and that's very good. This way (DL), educational/training possibilities can be much better focused, and possibilities and availability of educational opportunities are increased (and he needs them). In DL, it is also possible to choose only the courses one needs.
- He learned that there is still a long way to go to a good learning in DL. People are different. We have to respect/recognize well subtle aspects in difference between DL and face-to-face learning.
- He learned not to take a DL course if he is not ready for that.
- Before coming to NPS, he hasn't used the Internet much. Now he is much better in surfing, searching, solving problems.
- It additionally opened her eyes, enhanced her awareness on available options. She was a little skeptical about learning effectiveness in such course, but now she remembers very well many things from the course (2 months later). She is very interested in web technologies. It can be a very useful learning option, if it's done well.
- DL is the future, now he works much easier within it, uses it without being tensed, but he still doesn't have enough experience to compare it with other on-line courses. A course like this one can provide a student with better understanding of future educational/professional opportunities.

Tenth Question - Summary

The responses to tenth question were: 'no' – seven responses; 'only writing' – one student response; 'yes' – nine responses. Analysis of these responses shows something very interesting. Practically all the students who responded 'no' used one key explanation: they are already very experienced in IT and in using the Web. Quite differently, the students who responded 'yes' had very different reasons for their answers:

new learning opportunities, very different course (from other on-line course(s)), enhanced awareness on options, forums, etc. Only one of these responses used the same explanation as the students who answered 'no'. He explained he did not have much experience with the Internet. In other words, the first group of students ('no' responders) were more focused on only a single factor, while 'yes' responders had more diverse reasons.

11. Eleventh Question

The tenth question in the interviews was: 'I asked you many questions in the four on-line questionnaires and in this interview. If you think there's **anything else** I should know, but you haven't comment it yet, please feel free to do it now.'

Only one student didn't respond. Here are other comments, grouped into few typical sets of responses:

Technical recommendations

- It would be good if the server is set to e-mail replies to post automatically to original post writer's address. The instructor was the key to the success of the course - she acted exactly in accordance with tendencies of decentralized leadership style.
- A pilot-course had to be previously done in order to clean all 'bugs'. There was a lot of confusion with passwords. Too many questions in the beginning connected with technical problems, and if somebody is getting 'bad taste' because of that, that's bad for the course. Personally, he didn't see that as major problem, he is used to things like that, especially in the military.
- It's certain that some beginner's mistakes will not happen again. It all had to be tested better (pages, links), instead being fixed during the first two weeks.
- Technical problems have to be solved before the beginning of the course because they produce resistance in students. Fortunately, most of the students were in IT area and they are familiar with such problems. In general, it functioned well; it was designed intuitively.

Positive opinions

- She enjoyed the material. In on-line course it's easier not to study regularly - slacking off.
- It was pretty decent course, and nothing important was lost with transfer to DL delivering.
- The course was OK. People were trying hard, and he personally gave many well-intentioned recommendations to the instructor. The students were pretty constrained in the learning process (module after module). One can't go forward in advance, same as in 'classical' course. One can't learn at one's own pace.

Other advice, comments, and a question

- ***Skeptic:*** On-line is more time consuming – that's the key point. She is pretty skeptical about DL while on duty, even if it gives new opportunities. It all depends on student, how much time he/she invests into a course.
- ***More real-time events:*** She would prefer occasional real-time chat as an addition.
- ***Security:*** Security, log-ins and passwords have to be changed (they shouldn't be based on SSN). It's privacy issue!
- ***'Switch':*** Many students said they haven't learned much. He somewhat agrees, but that's because they compared the course to resident courses. For DL one has to make a 'switch' in one's own head. It is possible to just give minimum comfort in the course, but if a person has self-discipline and makes one's own conclusions, potentials for learning are great. Links to the newest information is an advantage for DL; books do not have that. The textbook was very good too.
- ***'Guinea pigs':*** Face-to-face courses have an advantage while in the school. He felt that his class was kind of guinea pigs, and that produced resistance in many students. Everything was not technologically ready for the course.
- ***Quizzes and tests:*** He probably gained the most on the final exam: he had to collect it all, to organize, to formulate as a recommendation to a boss - that was most useful. He would recommend more good tests, not too easy - maybe tougher, could be e-mailed to students, and no multiple runs through the test.
- ***A question:*** He asked why the UCF model was selected for application in NPS.

- ***'Psychological factors':*** On-line learning is very visual: some people don't like to learn like that. Maybe learning style should be tested before sending a person to DL course.

Eleventh Question - Summary

The final comments reflected the different backgrounds and priorities of the students. Some addressed technical problems in the course; others were more focused on the learning-environmental or psychological factors of the learning process. Their impressions varied, but were more positive than negative. Most of the comments contained useful recommendations and suggestions for further development and improvements of the course.

12. Interviews With The Students – Conclusions

The interviews were individual, semi-structured, conducted four to six weeks after the course was completed, and only with students who volunteered. Out of thirty, seventeen students agreed to give interviews. None of the students with less than an A-final grade were among them.

Eleven open-ended questions were asked in the interviews. They mostly addressed some important issues already explored through the on-line questionnaires.

When asked whether they learned more from the on-line than from face-to-face course, eleven students disagreed; four students thought the learning would be approximately the same, and only two students agreed. Two explanations for disagreeing were dominant: the course content and design, and student motivation. One student mentioned environment as a key reason. The students, who thought of the learning

efficiency as the same, did mention differences between DL and face-to-face courses, but with equal opportunities and results.

Asked about the usefulness of the forums, sixteen students saw them as 'useful', 'probably useful' or 'very useful, and only one student as 'not useful. Even in opposite responses, the same argument was used – the argument that the forum posts represented the student opinions, not factual material.

Ten students saw quizzes as useful, and six students as not useful. It seems that the difference found in opinions mostly comes from a different interpretation of the role of the quizzes in the course. Besides that, some students saw quizzes as useful, but anyway did not like them.

Interactivity issues were addressed in four questions. Predominantly, students thought the amount of interaction with the instructor in the DL environment was less than in the face-to-face classes (six said – 'much less'; eight – 'less'). Analysis of their responses suggests that their key explanation was the absence of the instructor's personal presence. Asked about the quality of interaction with the instructor, students most frequently thought it was good (seven students) or even better (two students), but a substantial number of students had the opposite opinion (five students – 'less'). Lack of the instructor's presence was again the main explanation in the latter case. Many students who thought quality of interaction was good or better mentioned some notable, but not overwhelming problems in the DL course. When questioned about the amount of interaction between the students, eleven students responded that there was less such interactivity in the course compared to a face-to-face course. Those who thought there was greater interaction, emphasized their explanations that students were forced or requested

to post to forums and thus to interact so much. Finally, students tended to see the quality of the interaction between students better than in a face-to-face class: eight said 'better', one – 'little better', and only three said 'worse'. Several students thought the quality was enhanced because they had to write postings, which stayed on a server until the end of the course. Some added that forum posts serve as references for further discussions and, therefore, the quality must be better.

Most students would think carefully about whether to choose an on-line or face-to-face course: twelve students responded it depends on the environment, on the nature of a course, and/or on the instructor. Only five students answered 'face-to-face', but most of them added that it might depend on the environment or other factors.

The students also gave interesting and applicable advice and recommendations. The recommendations were dealing with fixing the technical problems, organizing occasional meetings with the students, better defining what is expected from the students (all deliverables), and other issues.

In justifying their responses to the questions on the course as a new experience that includes some other benefits and not only the course objectives, students responding 'no' were focused on fact that most students were proficient in IT technology, while others, who responded positively, thought about several factors.

The last question asked the students to add other comment they wish. They responded with a wide spectrum of comments. The comments were mostly forthcoming recommendations for improvements of the course. Diversity of their responses reflected student backgrounds and priorities.

F. INTERVIEWS WITH THE INSTRUCTOR

I met with the instructor several times to talk about different issues of the course. I planned four sessions exclusively for interviews about the course. The questions I intended to ask at a particular interview were sent to the instructor in advance. I divided the instructor's responses by the main issues:

The instructor's preparations for the course

As soon as the instructor learned she had to design and deliver the course in on-line environment, she started to organize material into directories, resources, sources of information, what took approximately several (maybe five) hours a week, for three months. From the end of January to March 2000 (8 weeks in total) she attended an IDL 6543 (Interactive Distributed Learning For Technology-Mediated Course Delivery) course at the University of Central Florida. The course emphasized the development of web-based learning modules and on-line learning in general. During the course she developed a test-module (not included in the course later). From April to June 2000 she devoted 60% of her working time to course development.

Commander Higgins did not have any previous web-development or on-line teaching experience. She has no previous teaching/instructing experience at all except for briefings, group workshops, and seminars.

Preparations for an on-line course were a very creative process and it was a very positive and an intensive learning experience for her.

On the 'UCF model'

She fully supports the 'UCF model'. She believes that it is essential to enter into the transformation process and to ensure there is a supportive infrastructure for the

faculty. It is not 'mechanical' transformation into different media, but it is necessary to also start thinking in terms of how people learn and how best to use available tools to accomplish efficient learning.

The UCF model is process-focused and includes continuous revising of the materials and obtaining feedback from students. I found significant similarities between these principles of the UCF approach, the explanations the instructor gave me, and the students responses about the course. UCF ensures that every DL instructor collaborates with an instructional designer who is a constant link between the instructor and several UCF faculty members.

Initial problems in the course

Scheduling problem: 45 students appeared on first day, because of the mix-up in the Registrar's Office. She expected only 25 students. From this problem another one emerged – a problem with logins and passwords.

Second, during the first week of the course the UCF servers, which hosted the course on-line materials, did not function because of relocation to new offices. NPS students were not in the UCF databases of students, which caused additional problems with logons and passwords.

Firewall problem: some computers in NPS were configured differently than computers at the UCF campus, so unexpected problems with the firewall appeared. This was not discovered before the beginning of the course.

It took approximately two weeks to solve the problems described above. During one of the following weekends, the UCF servers were down, but during remaining time there were no similar problems.

Some of these technical problems were generated exclusively because of the circumstance that the course server was located on the UCF campus. This course was one of the first non-resident, non-UCF courses hosted³⁰ and supported by UCF, but taught at NPS.

Key lessons learned for the instructor, in light of the initial problems are:

- Complete all materials before the beginning of the course
- Limit size of the group. For instructor-beginner, it should not be over fifteen to twenty students.
- Assistant to the instructor, mostly for technical issues, but also for course design, content preparation, teaching issues, etc., is of essential importance.

Thinking about the beginning phase of the course, the instructor concluded she did not use the best approach: she set the stage and gave the roles to the students, and did not personally engage the on-line dynamics of the class as much. Because of problem solving process at the beginning of the course, the first week was an excellent, valuable experience for her. Also, she needed additional advice about moderating the forum discussion, which she got from UCF faculty and colleagues. In essence, the process of the instructor's improvement continued.

³⁰ i.e., UCF server hosted all on-line course materials.

Quizzes

Quizzes were not planned to be included in the final grade, but as exercises that provided important feedback to the students. It was not important how many points a student received, but the students did not quite understand the instructor's intention. Students did not like the word 'quiz', so the instructor decided to change it in the next iteration of the course to a 'self-assessment'.

The instructor was not aware that she would encounter so many technical problems with the quizzes. She was aware she would have an exceptionally high volume of work in the first iteration of the course. Therefore, she did not work on further development of the quizzes during the course. as much on any detailed further development of the quizzes. She decided to add more open-ended question to the quizzes.

This was the first on-line course to most of the students

The instructor was well aware that this course was the first on-line learning experience for almost all students. This fact could cause significant frustration for them. She knew that this fact was not so important, but still was a significant issue for the total amount of concern, but still she had to deal with it. Due to this fact, she told them that if the number of problems were too great they could drop the on-line section and enroll in the face-to-face section of the same course. For various reasons, ten students decided to do so: some because of their frustrations and some without any specific reasons. After that transfer, thirty-three students remained in this class.

After the first week of the course, comments and recommendations of the remaining students to the instructor were very constructive and useful. The instructor

concluded that after the first week the students demonstrated effective learning and proved to be able to use the course software.

Grading criteria

The instructor had a grading sheet for each student. Final grades were based on the following:

- 'Doing everything' in sense of reading module materials and participating in every forum on a *regular* bases Forums – initiative and responding
- Answering the quizzes regularly (number of points in quizzes was not so important)
- Final paper

According to the instructor's estimation, the first two criteria consisted of approximately 50% of the final grade, and the final paper the remaining 50%.

For grading the final papers, she had three criteria:

- Physical influences on space systems
- Impacts of commercial space operations to DoD
- Impacts of policies on accessing space systems

Good elaboration in all three areas in the final paper would mean an A grade for the final paper which was 50% of the final grade.

Since this thesis research questions address learning effectiveness, and final grades were only objective indicator of learning outcomes, the instructor's explanation of grading criteria is very important for interpretation of the results.

The student feedback to the instructor

The instructor thinks that students had different overall affective impressions about the course partially because they were 'different types of people in personal characteristics relevant to one's adaptation to a DL environment'.

Approximately half the students visited the instructor in her office. Most of them had a very positive opinion of the course. Very often they stated that while they were resident NPS students, they would prefer a face-to-face compared to the on-line course. However, they liked experience of an on-line course. Their responses in SOF were not surprise for the instructor, because she already received large amount of feedback from students.

The initial quality of student inputs in the forums far exceeded the instructor's expectations. The forum posts were very challenging to the instructor because she had to find optimal timing and way to moderate, facilitate, lead, and control the threaded discussions. On the other hand, trying to have complete control over that process would not be good.

Several students suggested real-time on-line chats or similar kind of interaction. Near the end of the course, their suggestions emphasized more the need for additional classroom sessions, maybe once a week or every 14 days. The instructor felt that need also. Such change would make this course a hybrid, not entirely web-based course. That could not be acceptable for all future non-resident students.

The instructor saw some of the students in the group only once during the first session before the on-line course actually began. However, even before the course was

over, the next quarter's students started to ask her about the on-line section and expressed significant interest. Another valuable source of feedback were SOFs.

What the instructor decided to improve for second iteration of the course

Other researchers in this area usually think that an instructor 'stabilizes' in the third iteration of the on-line course they teach. Based on experiences from the first iteration of the course, this instructor intends to:

- Increase amount of interaction with the students
- Reduce technical problems as much as possible
- Avoid last minute content preparations
- Rename quizzes to 'self-assessment' and improve them

Other lessons learned

The course was more time consuming for her than she had expected. Probably more unexpected problems appear in this type (on-line) of course than in face-to-face courses. The first iteration of an on-line course should not have many students, and the schedule should not be too tight. Especially at the beginning of the course, the instructor needs to have more reserve time, especially in terms of unexpected technical problems.

The instructor said her emphasis was on course implementation, not on course design, which includes redesigning after every good suggestion or recommendation from the students. This would not be rational.

Student perception of the course load in an on-line course follows different logic than in face-to-face courses, and an instructor has to be careful about this, especially when teaching such a course for the first time. Also, e-mail and forum communication

demands additional caution, which is different from the usual personal, verbal and nonverbal communication between an instructor and students.

Some students were anxious about the on-line course in the beginning. She had a line of the students in front of her office.

She plans to prepare more multimedia materials for the next iteration of the course, but not many because of the bandwidth problem. Some students do not have high-speed connections.

The instructor also added that not having previous face-to-face teaching experience might be an advantage for her. She did not have to unlearn face-to-face versions of the course and face-to-face methods of instruction did not interfere with the on-line teaching methods.

At the end, the instructor added that the policy on DL at NPS is changing in terms of enabling more people to attend DL courses in the Navy, not only in the fleet on carriers and ships, but also on shore. Also, the Navy scheduled significant improvements in bandwidth on ships. In other words, DL gained increased organizational support at NPS and in the Navy, which was an additional acknowledgement and motivator to the instructor of this course.

V. DISCUSSION

This thesis was initiated by the need for evaluation of one of the first on-line courses taught at NPS. That need was not only a consisting part of 'UCF model' of DL, but also an important step of permanently evolving instructional design process, and a part of academic and organizational culture in NPS – what is primarily embodied in mandatory Student Opinion Forms.

Studying a single case of relatively small number (thirty) of SS3011 on-line course students, I collected data from nine main different sources: four on-line questionnaires, SOFs, student on-line tracking, final grades, interviews with the students, and interviews with the instructor. Even though it was not possible to provide sophisticated level of data analysis (because of small sample, mostly ordered categorical data, and because large part of instruments was administered anonymously), many relations can be discussed and conclusions possible to drive.

Before integrating all findings and their implications and answering this thesis research questions, I will discuss results of each one of the data sources I used in this research.

The First on-line questionnaire (A-1 or 'The Basics'), administered at the beginning of the course, provided a quick overview about the students (quarter, service, pay grade), about their relevant previous experiences (on-line courses, space-related courses), computer and Internet user proficiency, expectations, and concerns. It may be said that as first of four on-line questionnaires it had secondary role of preparing the students for 'more serious' questionnaires to come. However, insight into responses and

into time the students needed in average to fill up a questionnaire on-line confirmed that they had no problems in completing them.

Finding that the students attending later quarters tend to visit the course homepage fewer times, to send fewer posts to forums (what includes follow up posts too) can be interpreted with important fact every NPS student has to learn – with the need for selection of information and for time management. Very likely, more ‘senior’ students tend to be more selective and more careful with their time, so this tendency seems reasonable.

The data indicated that vast majority of the students had neither previous experience in on-line learning nor experience in space-related courses. That is to say, this case study is about first application of an on-line course in Space Systems Academic Group, NPS, first time by this instructor, and as first DL course for almost all of these students. Briefly, this was a pilot project of NPS course transformed to DL using ‘UCF model’.

Most of the students perceived themselves as pretty proficient in using computers and in on-line search techniques (what was expected, having on mind their curriculum), and most of them expected to improve their learning through the on-line course. However, those with lower proficiency level and with lower on-line search skills had higher expectations for improvements, while more computer proficient students tended to read larger number of forum articles. According to these relations, it is doubtful that the question on expected learning improvement closely corresponds to ‘self-efficacy’, probably because of formulation of the question (it does not address any visible criterion, but only unclear term ‘improve learning’).

Self-perceived on-line search technique also has interesting correlations, first – with self-perceived computer proficiency, and second – with number of different course pages visited. The students more skilled in searching on-line visited fewer course pages probably because they find easier what they were looking for; they select information and save time.

Open-ended questions to this and other questionnaires provided very interesting qualitative data, which I analyzed using grouping of responses by meaning, i.e., by message(s) the responses were stating. In First questionnaire, student comments (last item) were more positive than negative, with few statements of personal preference of traditional classroom and few complaints about large forums.

In general, First questionnaire provided pretty positive picture and insight into relation between expectations and self-perceived proficiency before the course.

As Suchan and Crawford (1998) recommended, this research included relevant measures at different points in time (i.e., at different time points within the course), from orientation phase (First questionnaire and partly A-2 questionnaire) to the period after the course was completed (interviews with the students). This way, important aspects would not be missed. Also, I collected many qualitative data using on-line questionnaires and interviews. The instructor of SS3011 on-line course followed many other recommendations the authors listed in their paper.

The second questionnaire (A-2) was administered during second and third week of the course, after the students got clearer impression about the course. It was anonymous and had 26 items: 17 were five-point scales and the remaining were open-ended questions.

This questionnaire addressed much wider spectrum of issues than the first one. Responses on questions about comfort level mostly provided very desirable distributions, but on several issues there were individual students that had some problems: four students were 'somewhat uncomfortable' in setting their systems; one student 'extremely uncomfortable' in accessing the Internet; two students uncomfortable (one 'extremely' and one 'somewhat') in word processing; four students uncomfortable in posting to forums, etc. However, knowing for significant organizational and technical problems at the beginning of the course (reported by the instructor in the interviews), such distributions of responses were surprisingly positive.

Largely neutral responses to questions about comfort with technical support and help indicated that many students didn't need to use that help or were not aware of that option.

Their responses to open-ended question about needed technical help were mostly about posting to the forums, what was currently central technical problem.

Interpretation of the student responses to eight statements about comfort level with use³¹ of different features in the course (forums, e-mail, quiz, links, course overview, etc.) is not quite clear, because the question is whether these items represent student comfort level or effectiveness of respective features within the course. It depends, I would add, on how we define effectiveness. Of course, the student responses cannot be objective indicators, but their subjective views of supposed effectiveness.

³¹ These questions were targeting the way how these features supported learning process in the course, not how the students felt comfortable using them.

Analysis of correlations between the variables in this instrument showed that questions asking about comfort levels with IT³² activities and on-line activities present in the course (first five questions in the instrument), and the question about comfort levels with features used in the course, do correlate with at least six, but mostly with ten or more other variables. Several correlations were over 0.70. Four questions asking about comfort level with different forms of technical support had much fewer and in average much lower correlations – ranging from one to four statistically significant correlations with other variables. The interpretation is much harder in this case. Many responses were neutral for simple reason that the students have not used or were not aware of possibility of such support.

Very interesting were responses to the question asking them what they liked about the on-line course. I grouped nineteen responses as ‘time managements flexibility and accessibility’, what is very similar to findings of Moskal and Dziuban (2000).

I grouped students responses to the question about their concerns to: technical problems; uncertainty about comparability of DL to face-to-face courses; learning pace and organization; grading; and miscellaneous. This list of their concerns exceeds main problems the instructor outlined in interviews, what points to the benefits of this sort of feedback collection from DL students. Their responses reflected not only current problems they were facing in the course, but also issues every student meets – issues of self-organization and self-discipline (‘learning pace’) put into DL context.

Student responses to the question asking them how would they build and teach an on-line course were mostly recommendations for improvements of instructional methods

³² Information technology.

or for fixing technical problems. However, six students would not change anything from this course.

Module 14 questionnaire was administered close to the end of the course, asking the students three sorts of questions: how well the module 14 learning objectives were met; comfort level with the course features and relevant technical issues; and one open-ended question, asking for additional thoughts.

First seven items gave positive picture on module effectiveness in terms of met learning objectives. Only exception was the question on interaction with a subject matter expert (what made this module exceptional), because the number of neutral responses was very large compared to other six questions in that part. Possible explanation is students who chose neutral answers probably missed the opportunity to interact with the expert.

Responses to these seven statements significantly correlated with other variables from the instrument, but some also with some of the on-line student tracking indicators and few variables in First questionnaire.

The second group of questions was parallel to identical questions in Second questionnaire, so comparison of same variables in different time points in the course is made. Distributions were very similar, showing some improvements over the course. Most of them had several significant correlations, mostly with other question from this group and with on-line tracking indicators. Very interestingly, two questions (about comfort level with quiz feature used in the course and about comfort level with word processing) correlated with final grades too. All on-line tracking indicators had significant had significant correlations with other variables, some with several variables

from different instruments, what undoubtedly confirmed they have to be considered as important data source in DL effectiveness studies.

Comments added at the end of this questionnaire were mostly positive and constructive, but there were some hybrid comments, some complex, and some skeptical.

Final survey, the last of four on-line questionnaires in this research, were administered after the completion of the course, before the students got their final grades – so possible impact of grades to student responses was avoided.

First six questions followed the course learning objectives and most of the students responded positively. Only the question asking about usefulness of final exam in terms of helping a student to synthesize the concepts learned in the course had four negative responses. However, what is especially intriguing with these questions are correlations: most of significant correlations seemed to be in average most numerous and highest with other of these six questions, but that was not absolute rule. Correlations with some other questions were also significant, e.g. with questions on flexibility, questions on quality of interaction with the instructor, questions on usefulness of some of the features used in the course, or question on liking some of the course on-line features and activities. These correlations may seem irrelevant if one reviews theories mentioned in first two chapters, but they may raise new question and new, unexpected constructs in description and analysis of DL process. They are statistically significant and they seem to discover new relations, for which we still don't have theoretical terminology.

Seven next questions asked the students about usefulness of the following course features or elements: guidelines (two questions); textbook; on-line module readings; the links to websites; forum exercises; and quizzes. The distributions of these variables were

strongly positive, but some of them had notable number of negative responses too, those addressing usefulness of forums and quizzes. This was another confirmation that the students significantly differ in their interpretation and perception of forums and quizzes more than in interpretation and perception of other course features. Most of these seven variables had very few significant correlations: from one to four. Only exception was the question about usefulness of module readings, with ten significant correlations. Again, some of correlations were not expected and are hard to explain.

Liking of a course feature correlates with an opinion on its usefulness, but it is not the same. For instance, correlation between the responses about liking the forums assignments and the responses about usefulness of forum exercises was $\rho = 0.62$; correlation between responses about liking the textbook readings and responses about usefulness of the textbook was $\rho = 0.64$; the same for module readings was $\rho = 0.54$; and for website links $\rho = 0.56$. These are statistically significant but mild correlations. In cases of forum exercises/assignments and the textbook, these correlations were highest among very few other significant correlations, but for module readings and website links they were not. Moreover, in latter cases some other, unexpected correlations appeared to be higher, and there were much more significant correlations. The question asking about liking the module readings had ten, and the question asking about liking website links had nine significant correlations with other items in the instrument. Interpretation of this difference in numbers of correlations would be that latter two correlations (module readings and links) were more interrelated to many other factors of the course learning process, while examples like textbook or forum exercise represent more specific, relatively isolated sort of activities within the course context (the textbook is not on-line

feature, but is very important element of the learning process, while website links is the course material design and content feature). Among others, responses about some of aspects of interactivity (amount of interaction with other students and quality of interaction with the instructor) were also significantly correlated with two described features (module readings and website links).

The student responses to open-ended questions were very constructive and provided interesting recommendations. They had positive opinions on instructional strategies used in the course, but most of them didn't think the course fundamentally changed their approach to learning.

From responses to A-2 questionnaire we found that the students saw the flexibility (in sense of time management) to be very be beneficial. In Final survey the research went one step further and added two questions to determine whether that flexibility was beneficial only within the course or in terms of the student success in other courses. The student responses confirmed that the latter was more significant – the time flexibility was beneficial to this sample of students mostly in order to succeed in other courses.

The interactivity issues were among the most interesting points in this research. The student responses in Final survey showed that most of the students thought that amount of interactivity between the students and the instructor was less (compared to a face-to-face course). There was a similar trend concerning quality of interaction between the students and the instructor, but number of neutral responses clearly dominated. Similarly, the student responses on amount and quality of interaction between the students indicated decrease, with significant number of neutral responses and with few opposite opinions. This does not match findings of some other researchers. Wang,

Dziuban, and Moskal (2000) found that UCF students saw quality of interaction with the instructor increased in on-line courses, but findings about quantity were not so clear. Interactions with other students were perceived as slightly increased in quality, but it was not clear about the quantity (what also partially depends on way how we ask the students about their opinion – on-line or in mailed survey). According to Hartman, Dziuban, and Moskal (1999) and Moskal and Dziuban (2000), vast majority of faculty saw the amount and the quality of interaction significantly increased in comparison to face-to-face courses, especially in cases of fully on-line courses. However, the authors (Moskal and Dziuban, p. 26) anticipated that relation knowing that the faculty was requiring students to post to the forums, i.e., they were forcing students to interact. Similar was in the case analyzed in this thesis, and some of the student comments gave the same explanation.

The student responses to Long-Dziuban Reactive Behavior Protocol were surprising if compared to findings of other authors (Dziuban, Moskal, and Dziuban [1999]). In case of sample in this thesis research, much more students (50%) belonged to Passive Independent type (compared to 12% of UCF students in mentioned study). However, supposed differences between two populations, selectivity, environment, and other possible factors do not allow conclusions without additional and more focused research. Same holds for three found significant correlations.

Student Opinion Forms, administered on official NPS forms at the end of the course, also provided interesting information. Statistical analysis of responses was limited because of 'No comment' responses, which had to be excluded from calculations. Besides that, two questions seem not to be appropriate for DL environment and NPS should make changes in SOF forms to eliminate this problem.

Finding from First questionnaire about little importance of whether a student attend first or sixth quarter was confirmed in SOFs – this item did not have any significant correlations with other variables in this instrument. Same holds for number of credit hours.

All distributions were dominantly positive about different aspects of the course (respectively), with sporadic negative or neutral responses. Large number of correlations between the responses to SOF questions/statements was statistically significant, but they were reflection of targeted constructs the instrument was intended to assess. I would add that this thesis and other relevant follow-up theses and research might provide suggestions and recommendations what could be added, removed or changed in SOFs for DL courses to serve their purpose even better.

Some of the correlations provided additional in-depth insights into relations within DL learning context, like positive correlation between the student views of the instructor's course objectives made clear and the students feeling stimulated in the subject area. Such findings are closer to general pedagogical issues than to DL specifics.

Student on-line tracking data were one of surprises in this research. All tracking indicators had significant correlations with other variables: with other tracking indicators; with variables from First questionnaire, Module 14 questionnaire; and with final grades.

For most of the indicators, correlations with comfort level with quiz feature, posting to forum, accessing the Internet, and with some other variables, were exceptionally high. The instructor especially appreciated the student originality and initiatives in forums postings, what was proved by correlation between the number of original posts and the final grades.

The distributions of total number of hits or number of forum postings had wide ranges between individual minimums and maximums. There were over 500 postings in forums, and their length varied from just a few lines to several paragraphs of text, so it was not easy to synthesize their content. Also, brief analysis of dates and time of posting the forums messages by time in day and by day in week confirmed convenience and flexibility of DL course. Unfortunately, in this research it was not possible to examine relations of on-line tracking indicators with some other variables, like Long-Dziuban's reactive behavior types, what is one of possible directions for future research.

Conclusion from these findings about on-line tracking is clear: on-line tracking indicators are relevant in DL evaluation and can significantly contribute not only in evaluation efforts but also in further research of DL effectiveness factors.

The instructor stated in one the interviews that the student on-line activities were one of criteria for final grade. This is confirmed with significant correlations between final grades and all on-line tracking indicators. Final grades also had two other significant correlations, with comfort levels in quizzes and with comfort level in word processing. However, methodological limitations because of small sample and non-normal distributions indicate need for more thorough research, with large sample.

Interviews with the students were conducted for several reasons: first, they provided more qualitative data; second, it was possible to conduct them after the course, when the students were free of final exams pressure, and when they had substantial time distance from completed SS3011 course; third, my choice of the interview questions was inspired by the most controversial items from all four on-line questionnaires, by the research questions, and by the instructor's recommendations.

The most of the student did not think they learned more from on-line course than they would learn from a face-to-face course. However, they saw forums as useful and quizzes as relatively useful, and it seems that the differences in opinions occurred mostly because of different interpretation of the role of these features in the course.

Asked to compare the interactivity in the DL course with interactivity in face-to-face courses, they thought the amount of interaction with the instructor decreased, but the quality relatively increased or was the same. Similarly, most of them thought that amount of interaction between the students decreased in the on-line course, but the quality increased.

In a situation to choose, most of the students would consider taking on-line instead of a face-to-face course, but their decision would depend on the environment, the nature of a course, or on the instructor.

At the end of the interviews, the students provided many interesting comments and recommendations, which predominantly reflected their backgrounds and priorities.

The instructor provided many important statements about: her preparations for the course; her view of the 'UCF model of DL'; initial problems in the course; the grading criteria; the student feedback; needs for improvements in the course; and lessons learned. Her comments and explanations put new light on several issues present in the student responses in the questionnaires and the interviews, and without this part of the research many wrong conclusions could be made.

Having on mind all organizational and technical problems at the beginning of the course she described (exceptionally large number of the students appearing on first class,

firewall problems, software 'bugs', problems with UCF server being down, etc.), many negative student responses do not seem to address the course itself, but the described circumstantial problems. However, there were also many positive reactions from the students expressed in different occasions but not explicitly visible in the data collected in this research.

Teaching the on-line course for this instructor was creative, demanding, and continuous learning process, and she provided several lessons learned during the course, which are directed to some organizational issues, the course design and content issues, feedback to the students, etc.

The most astonishing fact from the interview with the instructor was that she did not have any previous experience in on-line teaching, but most of the data from this research confirmed that the course in general succeeded, in spite of this fact and all other problems I mentioned. Many experienced DL instructors assess that most often for a DL instructor is necessary to go through three iterations of teaching a DL course to become much more comfortable, stable, and successful. Organizational support is also important for an instructor's success, what also takes time and efforts in organizations where DL education is still not part of culture.

Looking back to the theoretical models presented in introductory chapter and in literature review, I must emphasize that the case analysis results cannot directly provide confirmation or results denying such models. Case study made on small sample and in specific circumstances cannot ensure firm data that could be generalized to such a model. However, quantitative and qualitative analysis confirmed that several groups of factors could be identified on the bases of their relations and qualitative analyses.

Learner's characteristics from Baldwin and Ford's model of learning design are certainly present and very important group of factors, what has support from various data in this research. One of factors in this group that should be considered in future research is Log's theory of reactive behavior patterns, but there are some other theories (like theory of learning styles) and constructs (efficacy, organizational commitment) that may play important role in DL effectiveness. Students varied by motivations and expectations. The research confirmed that more computer proficient students could have lower expectations to gain from a DL course. However, the responses depend on what has really been asked. In this research, the question about student expectations asked about improvement in learning, not general expectation.

Learning design was also addressed in large number of research items. The forums, website links, module objectives, guidelines, and numerous other design elements were examined. The data confirmed that there are many complex interrelationships between these and other issues during the course, including some unexpected relations, not known from existing literature. Qualitative analysis added more issues to be considered in future DL courses.

Work environment factors in this case were more visible from the instructor's than from the student side. There are many new initiatives in U.S. Navy supporting DL training and education, but that issue was not directly addressed in the research. The majority of students didn't know would their future duties include area covered by this course, so examining the role of opportunity to use the learned from the course didn't have much sense.

One of the findings in this research is probably the key role of interactivity, which in fact means feedback loops from the instructor to the students and vice versa, but also between the students. Role of the interactivity/feedback is mentioned in many other articles and addressed in several researches, but is not visible in these models.

Kraiger's classification of learning outcomes had indirect support in the data: the research found that *liking* a course feature or an element of the course content (affective outcome) and *being aware (i.e., know, be convinced) of its usefulness* (cognitive outcome) is not the same, but correlates. Improvements in using on-line activities (posting to forums, using links, etc.) represented skill-based outcomes, but not in terms of the course objectives, only in terms of skills necessary to successfully learn in DL environment.

The analysis of the student responses to questions about meeting the course objectives and of final grades (which was only objective measure of cognitive outcomes and in fact of course effectiveness) showed very complex relationships. Two sorts of data appeared to be most correlated with the grades and with the student responses about course objectives: on-line tracking indicators, and some 'general technical skills' indicators (comfort level in using forums, in sending e-mail, etc.). Only conclusions I can make

I would conclude that Belanger's framework for DL was closest to the reality of learning process within this on-line course. This model assumes bi-directional relations between the 'players' in the framework, I would suggest that crucial role of interactivity/feedback be explicitly stated in the model. Society impact and learning outcomes desired by the society are implicitly present in the case I examined, but there is

no need to comment it. All three sides – the learners, the instructor, and the institution (here the large part of institution's role was covered by UCF) – were present and interacted during the course.

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VI. CONCLUSIONS

In spite of the fact that this course was the first taught by the instructor and in spite of organizational and technical problems at the beginning of the course, the web-based SS3011 course design met desired learning outcomes.

The student expectations and motivation were predominantly positive, but not in consensus: small students were skeptical, and would rather attend a face-to-face course. On-line reactive behavior patterns found in this sample significantly differed from other studies, but there is not enough support in data for firm interpretation. The student affective reactions were predominantly positive. Utility reactions correlated with affective, but not strongly. Only slight positive changes over the course were detected.

Main lessons learned from this course are:

- Technical problems should be fixed as soon as possible, best before the course.
- The forums should be limited by number of participants and by size of posts.
- Feedback from an instructor is very important, but the other dimensions of interactivity (students to instructor; between the students) are also crucial for the success of an on-line course.
- An on-line course can provide desirable flexibility and convenience of use to resident students, but it would be more effective in non-resident environment.
- A course evaluation is an integral, important part of DL education. It should be conducted in different time points of the course, using qualitative, not only quantitative methods too.
- For an instructor, especially if it's his/her first DL teaching experience, DL course is very time-consuming, but creative process with lots of learning.

Other important findings of this research:

- The course organization was endangered by major scheduling problem at the beginning, but later it went on successfully.
- The pedagogy used in the course was very effective for most students, but small number of students had problems. Long's typology or some other approaches to individual differences relevant for DL learning could be used as helping tool in providing such students an adequate instructional counseling or other needed support.
- The technology used in this course had problems at the beginning, what underlines the need for adequate technical and organizational support to a DL instructor. Technology should be 'invisible', so the learning process would be more efficient and attractive to students and faculty.
- This research opened many possible directions for future research. Many correlations between the variables, trends, and other indications found in this research cannot be interpreted; some of the existing constructs should be reexamined, and may be some new created. The most important is to understand the complexity and interdependence of many factors relevant for effectiveness of a DL course.

APPENDIX A. A-1 QUESTIONNAIRE

NUMBER OF QUESTIONS: 25

THE BASICS


Your Demographics and Studying Strategies

The on-line Distributed Learning (DL) environment of SS3011, Space Systems Technology and Applications, is new to DoD and Naval Postgraduate School. We would like to gather data through the course that will assist us in improving future DL courses.

In an on-line course-learning environment, teaching strategies, in particular, are implemented in a manner that will enable students to take an active role in their learning. To achieve this goal, courseware developers have begun to think about ways to foster 'learner-centered' on-line instruction. This process has included not only looking at demographics of the adult learner, but also the professional/career goals and objectives as well as the studying strategies of those taking electronic courses. These types of data can assist courseware developers and researchers to ensure that 'teaching practices' are responsive to the needs of the on-line learner. Your help in responding to the following questions will aid us in this endeavor.

Question 1

Your e-mail address:

_____@_____	

Question 2

What is your student status for this course?

- ☐ 1. Full-time Student at NPS.
- ☐ 2. Full-time Military, Auditing Course.
- ☐ 3. Other.

Question 3

If you answered 'other' to the prior question, please enter your status here:

Question 4

About your academic and professional careers...

What is your Service?

- ☐ 1. USN
- ☐ 2. USMC
- ☐ 3. USA
- ☐ 4. USAF
- ☐ 5. OTHER - complete the following question.

Question 5

In the answer to the previous questions was 'other', please fill in your service here.

Question 6

What is your pay grade?

- ☐ 1. 01
 - ☐ 2. 02
 - ☐ 3. 03
 - ☐ 4. 04
 - ☐ 5. 05
 - ☐ 6. Other
-

Question 7

What is your Designator/MOS?

Question 8

Including this quarter, how many academic quarters have you been enrolled at NPS?

Answer:

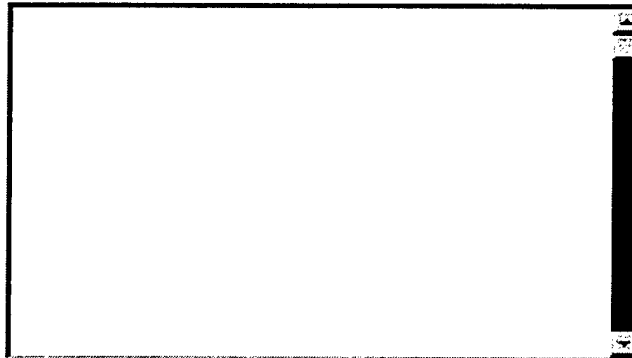
Question 9

What is your curriculum?

Answer:

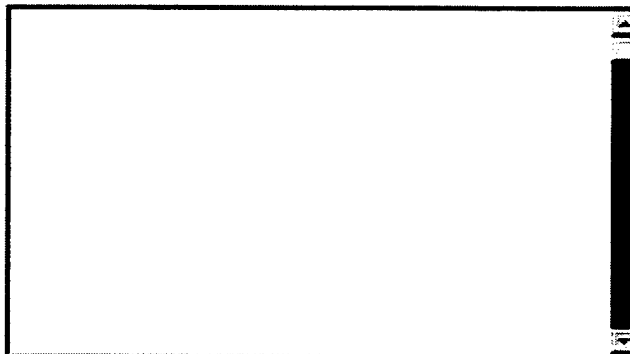
Question 10

List your previous jobs:



Question 11

Briefly list your previous duty stations and billets.



Question 12

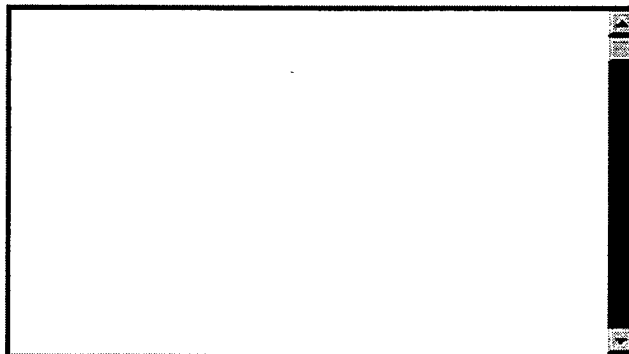
What is your next duty of assignment (if known)?

Answer:



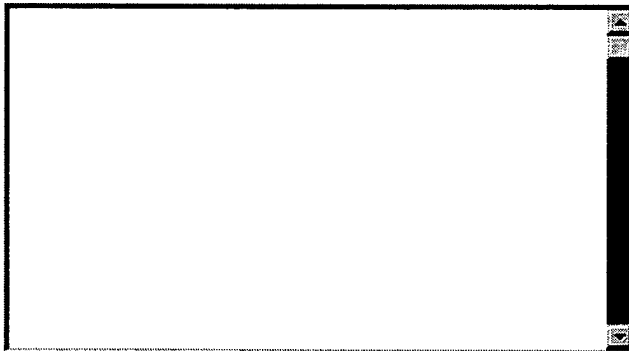
Question 13

List prior space system-related tours (e.g., commands/jobs).



Question 14

List previous university-level space systems-related courses.



Question 15

About your experience, to date, in taking an on-line course...

Title of on-line course you are enrolled in for this survey:

- ☐ 1. SS 3011 Space Systems - Technology and Applications.

Question 16

Have you experienced an on-line course (or courses) that used a web site to do/complete coursework?

- ☐ 1. No

☐ 2. Yes

Question 17

If you answered 'Yes' to the prior question, enter the number on on-line courses you have taken.

Answer:

Question 18

How often do you expect to use this course web site?

- ☐ 1. 3-5 times per week.
 - ☐ 2. 2 times a week.
 - ☐ 3. At least once a week.
 - ☐ 4. I don't know.
-

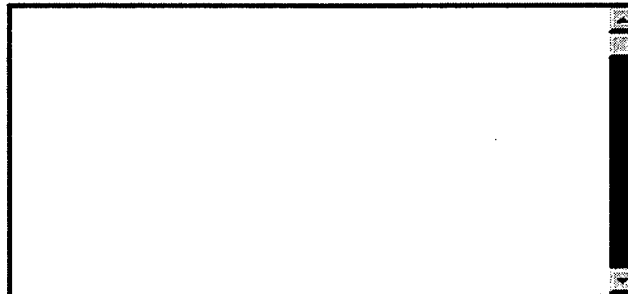
Question 19

The computer you plan to use most often to access the course is located:

- ☐ 1. In my BOQ room.
 - ☐ 2. In my house.
 - ☐ 3. In a computer lab on campus.
 - ☐ 4. At my place of work.
 - ☐ 5. In the library.
 - ☐ 6. In a shared area of my living quarters (e.g., home, BOQ, apartment, etc.).
 - ☐ 7. Other - complete following question.
-

Question 20

Please type in location/s, if the computer you plan to use most often is some place not listed in the prior question.



Question 21

On a scale of 1 to 5 where 1=novice and 5=expert, how would you rate your current proficiency in using computers?

- ☐ 1. 1
- ☐ 2. 2
- ☐ 3. 3
- ☐ 4. 4
- ☐ 5. 5

Question 22

On a scale of 1 to 5 where 1=novice and 5=expert, how would you rate your on-line search resources and techniques? [Five-choice scale, from 1 to 5.]

Question 23

Please indicate the extent to which you agree with the following statement:

I expect this on-line course will be valuable and improve my learning:

- ☐ 1. Strongly disagree.
- ☐ 2. Somewhat disagree.
- ☐ 3. Neutral.
- ☐ 4. Somewhat agree.
- ☐ 5. Strongly agree.

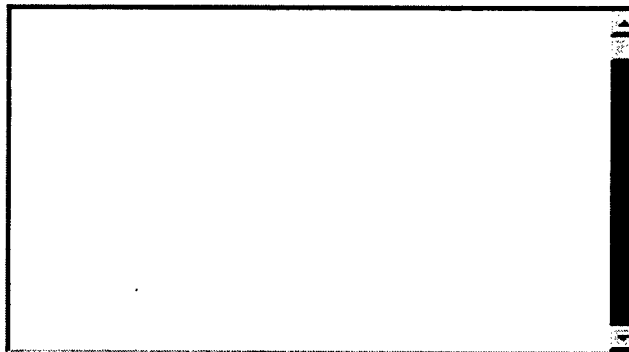
Question 24

Please indicate the extent to which you agree with the following statement:

I am concerned about my ability to use the web-based materials in this class: [Five-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 25

Any additional comments, concerns, or suggestions are welcome:



APPENDIX B. A-2 QUESTIONNAIRE

NUMBER OF QUESTIONS: 26

**You Have Completed The Orientation Portion Of This Course.
How Are Things Going So Far?**

Question 1

How would you rate your comfort level at this point with setting-up your system?

- ☐ 1. Extremely uncomfortable.
- ☐ 2. Somewhat uncomfortable.
- ☐ 3. Neutral.
- ☐ 4. Somewhat comfortable.
- ☐ 5. Extremely comfortable.

Question 2

How would you rate your comfort level at this point with accessing the Internet? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 3

How would you rate your comfort level at this point with word processing? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 4

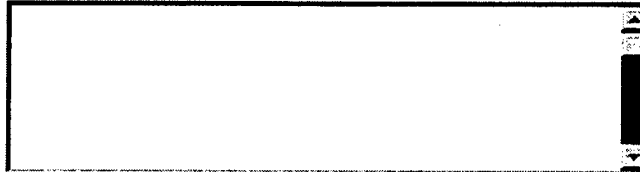
How would you rate your comfort level at this point with posting to the forum? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 5

How would you rate your comfort level at this point with sending electronic mail? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

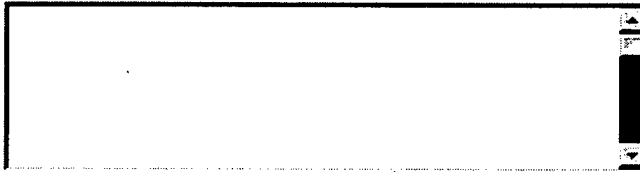
Question 6

In what areas of the on-line technologies (system set-up, accessing the internet, word-processing, posting to forums) do you still need help?



Question 7

Please provide any additional thoughts.



Question 8

How would you rate your comfort level at this point with the technical support provided for using the WebCT software?

- ☐ 1. Extremely uncomfortable.
- ☐ 2. Somewhat uncomfortable.
- ☐ 3. Neutral.
- ☐ 4. Somewhat comfortable.
- ☐ 5. Extremely comfortable.

Question 9

How would you rate your comfort level at this point with the technical support available to you through your Internet service provider (ISP)? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 10

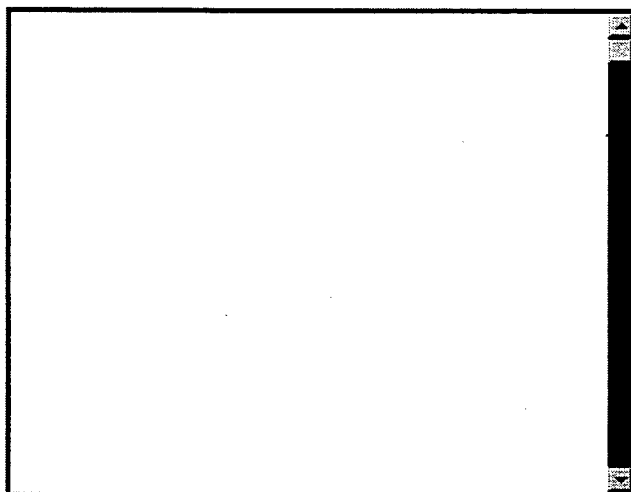
How would you rate your comfort level at this point with the technical support available to you through the university ADP office? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 11

How would you rate your comfort level at this point with the technical support available to you on CD-ROM? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

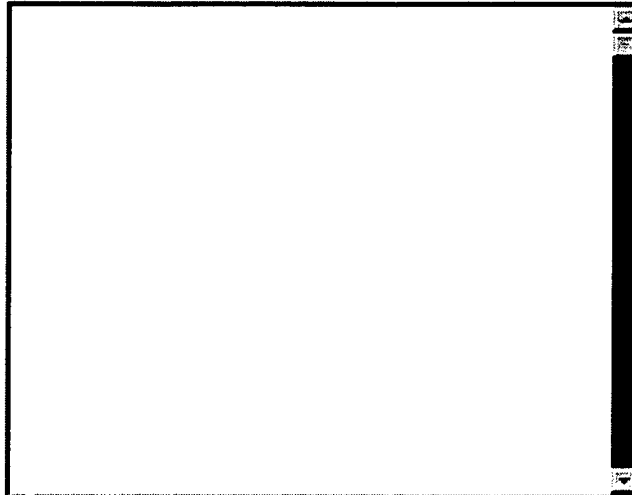
Question 12

What technical issues (e.g., those related to WebCT, Internet Services, Local ADP, CD-ROM, etc.) do you still need to resolve?



Question 13

Please provide any additional thoughts.



Question 14

How would you rate your comfort level at this point with the **forum feature** being used to teach this course? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 15

How would you rate your comfort level at this point with the **email feature** being used to teach this course? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 16

How would you rate your comfort level at this point with **quiz feature** being used to teach this course? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 17

How would you rate your comfort level at this point with the **links** (i.e., additional web sites) **feature** being used to teach this course? [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 18

How effective was the **course overview**? That is, to what extent did the **course overview** help you to understand **what you would learn** in the 'Space Systems - Technologies and Applications' on-line course. [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 19

How effective were **module objectives**? That is, to what extent did the **module objectives** help you to understand **what you would learn** in the 'Space Systems - Technologies and Applications' on-line course. [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 20

How effective were the **rules of engagement**? That is, to what extent did the **rules of engagement** help you to understand **what would be involved** in taking the 'Space Systems - Technologies and Applications' on-line course. [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 21

How effective was the **course syllabus**? That is, to what extent did the **course syllabus** help you to understand **what you would learn** in the 'Space Systems - Technologies and Applications' on-line course. [Five-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 22

In what areas do you still need help with the web-based technological features (forum, email, quizzes, links, etc) used to teach this on-line course?




Question 23

So far, what do you like about this on-line course?



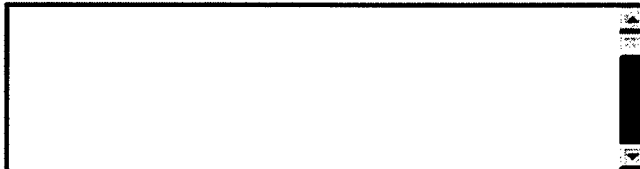
Question 24

So far, what are your concerns about this on-line course?



Question 25

Please respond to the following question: 'If I were building an on-line course to teach space systems-related instruction, I would...'



Question 26

Do you have any suggestions, at this point (in particular, about your orientation to taking a course on-line)?



APPENDIX C. A-14 QUESTIONNAIRE

Module 14 Evaluation	
Name:	
Number of Questions: 14	

Throughout **Module 14** you developed and practiced your skills in the process of analyzing, articulating, and evaluating DoD Space Control issues. The statements below reflect the learning objectives for Module 14. To what extent do you agree that the material presented in the Module enabled you to achieve the learning objectives?

Question 1

Identifying key elements of Space Control. (Check one of seven points that fits your opinion best.)

- ☐ 1. Strongly disagree.
- ☐ 2. Disagree.
- ☐ 3. Slightly disagree.
- ☐ 4. Neutral.
- ☐ 5. Slightly agree.
- ☐ 6. Agree.
- ☐ 7. Strongly agree.

Question 2

Synthesizing other's findings in Forums. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 3

Interacting with a subject-matter expert whose knowledge you can use to solve space-system problems. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 4

Participating in forums (e.g. discussing, identifying/consulting subject matter experts), to evaluate space control issues. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 5

Articulating how the concept of space control relates to Joint Vision 2020. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 6

Evaluating the likelihood that various types of space countermeasures might be used across the peace-war continuum. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 7

Identifying elements of space systems that are vulnerable to disruption, degradation or destruction by adversaries. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 8

In Evaluation A2 we asked you several questions about your comfort level after the orientation part of the course. Now, when the course is practically over, we would like you to reassess some of these issues, i.e. to think how your comfort level really was throughout the course.

How would you rate your comfort level at this point with accessing the Internet? (Check one of seven possible answers.)

- ☐ 1. Extremely uncomfortable.
- ☐ 2. Uncomfortable.

- ☐ 3. Somewhat uncomfortable.
 - ☐ 4. Neutral.
 - ☐ 5. Somewhat comfortable.
 - ☐ 6. Comfortable.
 - ☐ 7. Extremely comfortable.
-

Question 9

How would you rate your comfort level at this point with sending electronic mail? [Seven-choice scale, from 'Extremely uncomfortable' to 'Extremely comfortable'.]

Question 10

How would you rate your comfort level at this point with posting comments to the Forums? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 11

How would you rate your comfort level at this point with quiz feature being used to teach this course? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 12

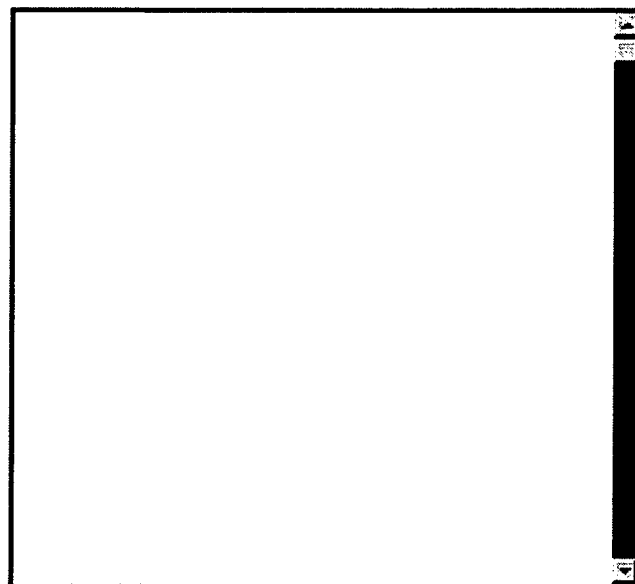
How would you rate your comfort level at this point with the links (i.e., additional web sites) feature being used to teach this course? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 13

How would you rate your comfort level at this point with word processing? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 14

Please provide any additional thoughts.



APPENDIX D. FINAL SURVEY QUESTIONNAIRE

Number of Questions: 31

Please answer the following questions as honestly as you can. The information will be compiled and evaluated by a thesis student and will serve as NPS's foundation for building future on-line courses. Thanks for taking the time to participate.

CDR Sue Higgins

Question 1

As a result of your overall experience in this course, do you feel that you are able to articulate how physical influences on space systems impact our ability to use those systems in military operational situations?

- ☐ 1. Strongly disagree.
 - ☐ 2. Disagree.
 - ☐ 3. Slightly disagree.
 - ☐ 4. Neutral.
 - ☐ 5. Slightly agree.
 - ☐ 6. Agree.
 - ☐ 7. Strongly agree.
-

Question 2

As a result of your experiences in this course, are you able to articulate how political, organizational and economic influences impact how we use space systems in military operational settings? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 3

Do you feel that you are able to articulate how commercial space systems will impact military operations? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 4

Was the final exam useful in helping you to synthesize the concepts learned in the course?

- ☐ 1. Extremely useless.
- ☐ 2. Useless.
- ☐ 3. Slightly useless.
- ☐ 4. Neutral.
- ☐ 5. Slightly useful.
- ☐ 6. Useful.
- ☐ 7. Extremely useful.

Question 5

I feel confident in my ability to access appropriate resources, such as subject matter experts, documentation of websites, or late breaking news for evaluating uses of space systems in operational situations.

- ☐ 1. Strongly disagree.
- ☐ 2. Disagree.
- ☐ 3. Slightly disagree.
- ☐ 4. Neutral.
- ☐ 5. Slightly agree.
- ☐ 6. Agree.
- ☐ 7. Strongly agree.

Question 6

I feel confident in my ability to get involved in open discussions with my peers to weigh issues related to using space systems in operational settings. [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 7

How useful were the guidelines provided in the course homepage to your ability to succeed?

- ☐ 1. Extremely useless.
 - ☐ 2. Useless.
 - ☐ 3. Slightly useless.
 - ☐ 4. Neutral.
 - ☐ 5. Slightly useful.
 - ☐ 6. Useful.
 - ☐ 7. Extremely useful.
-

Question 8

How useful were guidelines provided at the course homepage for posting substantive responses to the Forums? [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 9

How useful was the textbook in helping you understand the course concepts, objectives and principles? [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 10

How useful were the on-line Module readings in helping you to understand the course concepts, objectives and principles? [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 11

How useful were the linked websites in helping you to understand the course concepts, objectives and principles? [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 12

How useful were the Forum exercises in helping you to understand the subject matter? [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 13

How useful were the Quizzes (2, 3/4/5, 6/7) for providing feedback in your understanding of the material for those Modules? (Try to separate the technical problems with the early quiz from your answer.) [Seven-choice scale, from 'Extremely useless' to 'Extremely useful'.]

Question 14

How did you like the Forum assignments?

- ☐ 1. Strongly disliked.
 - ☐ 2. Disliked.
 - ☐ 3. Slightly disliked.
 - ☐ 4. Neutral.
 - ☐ 5. Slightly liked.
 - ☐ 6. Liked.
 - ☐ 7. Strongly liked.
-

Question 15

How did you like the textbook reading assignments? [Seven-choice scale, from 'Strongly disliked' to 'Strongly liked'.]

Question 16

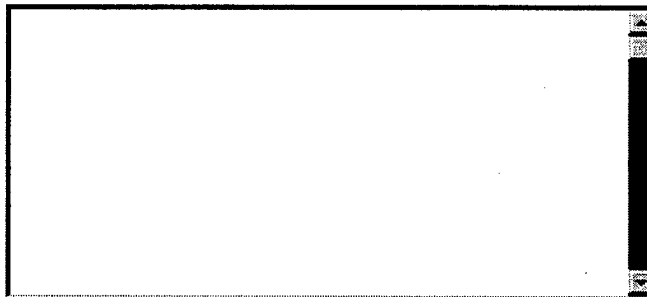
How did you like the Module readings? [Seven-choice scale, from 'Strongly disliked' to 'Strongly liked'.]

Question 17

How did you like the website links that were provided? [Seven-choice scale, from 'Strongly disliked' to 'Strongly liked'.]

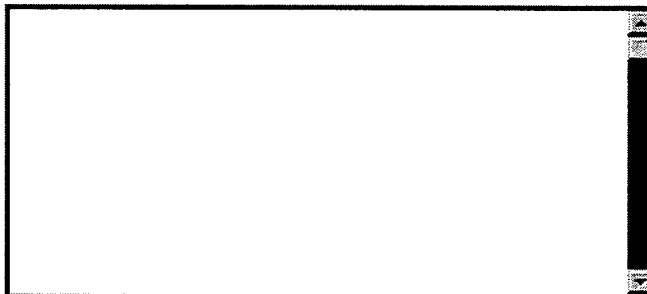
Question 18

What other instructional materials, if any, should be included in the course?



Question 19

Describe your reaction to the instructional strategies used to teach the subject matter (textbook readings, forums, websites).



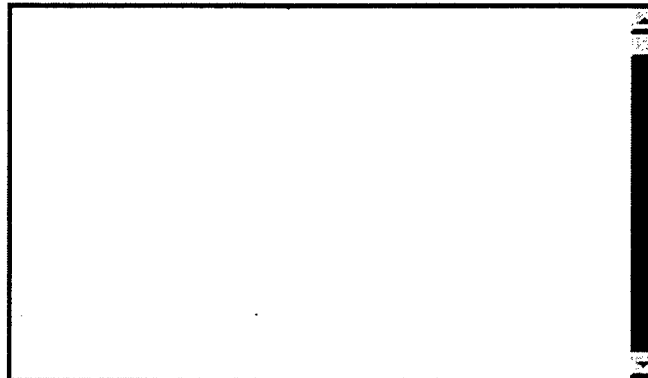
Question 20

I am certain that I am able to synthesize information from a variety of sources to enable me to use space systems in operational situations.

- ☐ 1. Strongly disagree.
- ☐ 2. Disagree.
- ☐ 3. Slightly disagree.
- ☐ 4. Neutral.
- ☐ 5. Slightly agree.
- ☐ 6. Agree.
- ☐ 7. Strongly agree.

Question 21

As a result of this on-line course experience, do you feel that you have changed your fundamental approach to learning? Please respond 'yes', 'somewhat' or 'no', and explain your answer.



Question 22

Did you view the flexibility of this on-line course as beneficial to your ability to succeed in this class?

- ☐ 1. Strongly disagree.
- ☐ 2. Disagree.

- ☐ 3. Slightly disagree.
- ☐ 4. Neutral.
- ☐ 5. Slightly agree.
- ☐ 6. Agree.
- ☐ 7. Strongly agree.

Question 23

Do you feel that the flexibility of this class helped you succeed in other classes that you were taking in the same quarter? [Seven-choice scale, from 'Strongly disagree' to 'Strongly agree'.]

Question 24

Compare the amount of interaction you had with the instructor for this on-line course as compared with a similar resident 'face-to-face' course (note - this question is about 'amount'; another question will cover 'quality of interaction'). Try to consider only the amount of interaction that occurred on-line (including e-mails)- as opposed to what occurred if/when you stopped by the instructor's office.

- ☐ 1. In this on-line class I had *significantly less* interaction with the instructor than I would have in a similar face-to-face class.
 - ☐ 2. In this on-line class I had *less* interaction with the instructor than I would have in a similar face-to-face class.
 - ☐ 3. In this on-line class I had *slightly less* interaction with the instructor than I would have in a similar face-to-face class.
 - ☐ 4. The amount of interaction between the instructor and me was *about the same*.
 - ☐ 5. In this on-line class I had *slightly more* interaction with the instructor than I would have in a similar face-to-face class.
 - ☐ 6. In this on-line class I had *more* interaction with the instructor than I would have in a similar face-to-face class.
 - ☐ 7. In this on-line class I had *significantly more* interaction with the instructor than I would have in a similar face-to-face class.
-

Question 25

Compare the quality of interaction between yourself and the instructor in this on-line class against what you would have expected in a similar "face-to-face" class.

- ☐ 1. In this on-line course the quality of interaction between the instructor and myself was of **significantly less** quality than it would have been in a face-to-face class.
- ☐ 2. In this on-line course the quality of interaction between the instructor and myself was of **less** quality than it would have been in a face-to-face class.
- ☐ 3. In this on-line course the quality of interaction between the instructor and myself was of **slightly less** quality than it would have been in a face-to-face class.
- ☐ 4. The quality of interaction between the instructor and myself was **about the same**.
- ☐ 5. In this on-line course the quality of interaction between the instructor and myself was of **slightly greater** quality than it would have been in a face-to-face class.
- ☐ 6. In this on-line course the quality of interaction between the instructor and myself was of **greater** quality than it would have been in a face-to-face class.
- ☐ 7. In this on-line course the quality of interaction between the instructor and myself was of **significantly greater** quality than it would have been in a face-to-face class.

Question 26

Compare the amount of interaction you had with other students for this on-line course as compared with a similar resident 'face-to-face' course (note - this question is about 'amount'; another question will cover 'quality of interaction'.)

- ☐ 1. In this on-line course I had **significantly less** interaction with other students than in a similar face-to-face course.
- ☐ 2. In this on-line course I had **less** interaction with other students than in a similar face-to-face course.
- ☐ 3. In this on-line course I had **slightly less** interaction with other students than in a similar face-to-face course.
- ☐ 4. The amount of interaction was **about the same**.
- ☐ 5. In this on-line course I had **slightly more** interaction with other students than in a similar face-to-face course.
- ☐ 6. In this on-line course I had **more** interaction with other students than in a similar face-to-face course.
- ☐ 7. In this on-line course I had **significantly more** interaction with other students than in a similar face-to-face course.

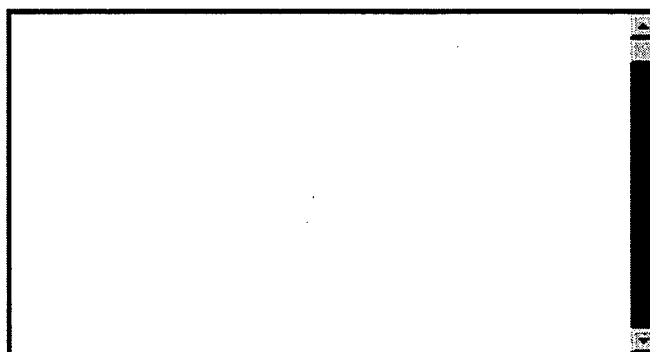
Question 27

Compare the quality of interaction you had with other students for this on-line course as compared with a similar resident 'face-to-face' course.

- ☐ 1. In this on-line course the quality of interaction between myself and other students was of ***significantly less*** quality than it would have been in a face-to-face class.
 - ☐ 2. In this on-line course the quality of interaction between myself and other students was of ***less*** quality than it would have been in a face-to-face class.
 - ☐ 3. In this on-line course the quality of interaction between myself and other students was of ***slightly less*** quality than it would have been in a face-to-face class.
 - ☐ 4. The quality of interaction was ***about the same***.
 - ☐ 5. In this on-line course the quality of interaction between myself and other students was of ***slightly greater*** quality than it would have been in a face-to-face class.
 - ☐ 6. In this on-line course the quality of interaction between myself and other students was of ***greater*** quality than it would have been in a face-to-face class.
 - ☐ 7. In this on-line course the quality of interaction between myself and other students was of ***significantly greater*** quality than it would have been in a face-to-face class.
-

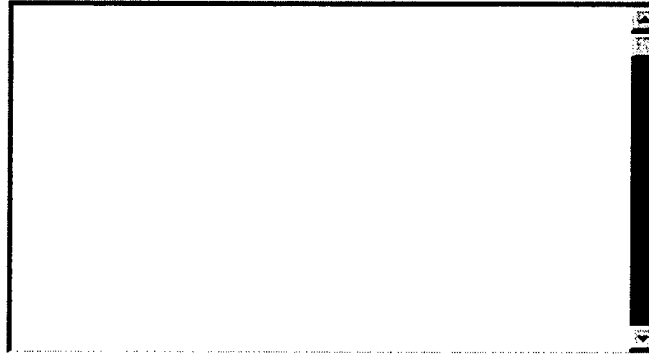
Question 28

Describe your reaction to the media used to present the instruction (i.e. online delivery instructional technologies.)



Question 29

If you wish to add any other comments about the course, use this space.



Question 30 (Copyright 1998 © William A. Long and Charles D. Dziuban)

This question will try to capture your personal traits that are related to your on-line learning style. These questions are very easy to answer, but may take some effort to think honestly about yourself. We stress that your responses will be used anonymously for research purposes only. The following sets represent main types of on-line learning styles. The types are not what people think they should be like, or what sounds like a desirable description, but rather as people really are. Choose what was closest to you as you went through this on-line course.

- ☐ 1. Highly energized and action-oriented. Little need for approval; unconcerned with who they please. Put thinking into immediate action. Very frank, speaks out freely. Has no problems confronting people.
- ☐ 2. Lower energy level. Little need for approval - unconcerned with pleasing others. Independent & strong-willed. Prefers to work alone. May resist pressure from authority. Independent thinker.
- ☐ 3. Highly energized and productive. Strongly motivated by approval. Sensitive to the wishes of others. Translates energies into constructive tasks. Deeply values close bonds with others. Some difficulty dealing with direct confrontation. Highly idealistic, setting lofty goals for themselves. Foster harmonious relationships.
- ☐ 4. Lower energy level. Needs approval - concerned with pleasing others. Rarely shows anger or resentment. Very sensitive to the feelings of others. Very compliant and loyal. Forms strong attachments. Gives and thrives on affection.

Question 31 (Copyright 1998 © William A. Long and Charles D. Dziuban)

Please read carefully the descriptions in the four boxes below. Although not all behaviors may fit you exactly, select as many boxes that you feel apply to you. Here you may pick from none to four boxes.

- ☐ 1. Thinks of all possibilities and contingencies before venturing into activities. 'What if' person. May see the negative side of things. Unwilling to take risks.
Highly organized and methodical. Strongly motivated to finish tasks.
 - ☐ 2. Perfectionist. Tends to form habits. Extremely diligent in work habits. May be mildly ritualistic.
 - ☐ 3. Sometimes explosive and quick tempered. Sharp tongued. Very frank. May act without thinking.
 - ☐ 4. Dramatic. May have wide mood swings. May overreact in some situations. Can have emotional outbursts. Artistically inclined. Devalues work routine.
-

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APPENDIX E. INTERVIEWS

INTRODUCTION

SS3011 on-line course has finished just a couple of months ago. Now you have nice time distance from the course, so your impressions and opinion about it are more clear and final. The purpose of this brief interview is to try to capture some of your deeper insights and conclusions about your experience of that course.

As in all four on-line evaluation questionnaires you answered during the course, your answers will be used only for my thesis research and your identity will be protected. Please answer them straightforward and comment as you wish.

QUESTIONS

1. In general, could you estimate **have you learned more** from the on-line designed course than you would learn from a face-to-face SS3011 course? I'm asking you about successful learning of subject matter taught through distributed learning, not about particular instructor or anything else.
2. Students' answers about forums exercises were very different, in terms of forum exercises being useful in helping to understand the subject matter. What is your final opinion about their real **usefulness in facilitating your learning**? Also, comment how much you **liked** using forums.
3. The same question about Quizzes – please comment how **useful** they were for you and how much you **liked** them!
4. Students' answers to question about how they saw **the amount of interaction with the instructor** during the SS3011 course, compared to a similar resident (face-to-face) course, were very different. Please comment your view.

5. I want to ask you similar question about the **quality of students' interaction with the instructor**, compared to a resident course. How you saw it?
6. One of most controversial questions, according to students' answers, was about the **amount of interaction between the students**, compared to a face-to-face course. Some thought SS3011 offered significantly less interaction, some others – significantly more. What's your comment?
7. The last question about interactions covers the issue of **quality of interaction between the students**, what is important for the learning process. How would you comment it, in sense of comparing the quality of interaction between students in on-line SS3011 with interaction between students in some similar face-to-face course?
8. If you have an opportunity to choose between on-line and face-to-face section of some other class in your curriculum, what would you do? (*Examples: I would surely go online; depends on nature of the course; depends on my schedule; surely stay in face-to-face section...*)
9. Please tell us any **advice/recommendation/suggestion** you have for CDR Higgins or any other NPS or Navy distributed learning instructor. (*This question is very open-ended!*)
10. This course was not only a space-systems course, but also a **new experience** for most of the students in the section. Looking at the course from this time distance and **in general**, do you think you've **gained some other benefits besides the course objectives themselves**? Please comment.
11. I asked you really many questions in the four online questionnaires and in this interview. If you think there's **something else** I should know, but you haven't comment it yet, please feel free to do it now.

At the end, I just want to express my appreciation for your time, patience and efforts. I will do my best to make it maximally beneficial for future students, instructors and NPS in general, what your answers made possible. Thank you!

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